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TEXTILE. PIELĂRIE

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Secţia VIII
TEXTILE. PIELĂRIE

OPTICAL BIREFRINGENCE – A METHOD FOR ESTIMATING THE MORPHOLOGICAL STRUCTURE OF THE TEXTILE FIBERS

BY

OTILIA MÂLCOMETE and V. BLAŞCU

1. Introduction. The optical properties of textile fibers may be grouped into two categories, according to their characteristics, namely:
qualitative (glow/lustre, glance, colour) and quantitative properties (refraction indices for the two directions, parallel and perpendicular to the fiber's axis, the degree of whiteness, etc.) [1].

The optical characteristics are determined by the crystallization state and by the "crystalline-amorphous" ratio of the polymers forming the fiber, "the crystal" playing the role of light selector that transforms natural light into polarized light [2].

Textile fibers are characterized by anisotropy of their properties, known as depending upon a series of structural agents, such as: the crystallites orientation degree, the orientation degree of the macromolecules from the amorphous regions, the crystallinity index, the matter's density, as well as the content of additive substances in the fibers [3, 4].

Consequently, optical birefringence represents a quantitative parameter of special significance for evidencing certain structural elements, related to the general orientation of the textile fibers. The arrangement of the macromolecular chains according to a preferential direction (the fiber's axis) induces the fiber's optical anisotropy, whose measure is birefringence itself [1, 5]. Thus, between the values of optical birefringence and the fibers' physical and mechanical properties, a strong interdependence is manifested, leading by correlating this parameter with other characteristics, to getting as exact as possible information upon their structure [6, 7].

At the same time, knowing the values of intrinsec birefringence of the crystalline and amorphous stages of a fiber, as well as the crystalline fraction (as determined by the method of the density gradient column), the function of amorphous

orientation may be calculated [6, 7].

Establishment of the orientation factor in the fiber's amorphous phase represents a highly sensible measure for estimating the modifications intervening during certain mechanical stresses (such as those involved in processes of drawing or textile and chemical processing), the amorphous regions being known as suffering the most significant modifications, while the crystalline phase is much more stable [1, 7].

2. Experimental. For determination of the optical birefringence, a polarizing Amp.pol.d. microscope (Carl Zeiss Jena) has been used, by employing coresponding compensators (i.e., devices for measuring the difference of optical path) whose domains were $\lambda = 0...6$ and $\lambda = 133$, on considering that optical birefringence varies from one fiber to another, within very large ranges.

Thus, Δn birefringence is calculated from the relation:

$$\Delta n = \frac{\Delta\lambda}{d}$$

where: $\Delta\lambda$ is the phase difference or the "delay" produced by the sample for the two waves, nm;

d – the fiber's thicknes (as measured in the fiber's compensation zone), nm.

P.H. H e r m a n s considers that an ideally-oriented fiber (i.e. having all its elements structural parallel to the fiber's axis) has the orientation factor equal to 1, while the orientation factor of an anisotrope fiber is equal to zero [8].

The relation established between the orientation factor and birefringence has been defined by H e r m a n s as:

$$f_o = \frac{\Delta n}{\Delta n_{max}} = 1 - 3/2 \sin^2 \alpha$$

where: α is the angle to which all macromolecular chains should be oriented, so that to determine the same birefringence as in a normal fiber;

Δn_{max} – ideal birefringence.

In the case of natural cellulosic fibers, Δn_{max} (the birefringence of an ideally oriented fiber) is 0.074 (as established by H e r m a n s for highly oriented ramie fibers, which correspond to cellulose I) while for artificial cellulosic fibers (to which the crystalline cell corresponds to cellulose II), the birefringence of the mercerized ramie fiber, i.e. 0.055 has been taken as reference value.

With synthetic fibers, a more precise quantitative estimation may be performed by determining the orientation of the amorphous phase, as deduced from the relation of the total birefringence, Δn:

$$\Delta n = \Delta_c^\circ \cdot f_c \cdot X_c + (1 - X_c)\Delta_{am}^\circ \cdot f_{am} + \Delta f$$

where: Δ_c° – intrinsic birefringence of the crystallites (the birefringence of a 100% crystalline sample);

f_c – the crystallites' orientation factor (as determined by RX diffraction);

X_c – the crystalline fraction (determined through density);

Δ°_{am} – intrinsic birefringence of the amorphous phase (a 100% oriented sample in the amorphous region);

f_{am} – the amorphous orientation factor;

Δf – formal birefringence, insignifiant as compared with the other two phases and thus, liable to annulment.

The amorphous orientation factor may be calculated with the relation:

$$f_{am} = \frac{\Delta n - \Delta^{\circ}_{c} \cdot f_c \cdot X_c}{(1 - X)\Delta^{\circ}_{am}}$$

The fibers analyzed in this study have been selected according to the polymer's nature and chemical structure, such as:

1. fibers having – OH groups, namely:

1.1. cellulose based fibers: – native cellulose; cotton (of different origins),

– regenerated cellulose: viscose (classical celofiber and polynose-type, as well as filamentary yarns with various degrees of fineness);

1.2. syntetic, polyalcohol vinylic (PAV) fibers, unsolubilized fibers and soluble filamentary yarns;

2. fibers having an aromatic nucleus in their structure, such as: polyesteric (PET) fibers, textured by various technologies, having various degrees of fineness.

The results of the values of optical birefringence, as correlated with the other properties of the fibers, are presented in Tables 1 and 2.

In the case of cotton fibers, optical birefringence is seen as being correlated with the degree of maturity (determined by measuring the walls' and the canal's thickness [9, 10], i.e., on increasing the fiber's maturity, the orientation of the structural assemblies also increases, their parallelism towards the longitudinal axis of the fiber being stressed, which is evidenced by a corresponding decrease of the gradient angle, α_m.

On increasing the orientation, there increases too, its tenacity and density (as determined by picknometric method).

In the case of viscose-based fibers (classical cellofiber and polinose), significant differences do exist between these types of cellofibers; they are mainly evidenced by the values of optical birefringence, as well as by their density and tenacity, which take obviously higher values with polynoses (as the result of a different orientation).

In the case of viscose filaments, there also exist structural differences among the three types of yarns; thus, mention must be made of the fact that finer filaments (T=11 den) are more ordered, which is a result of a more pronounced drawing, as compared to those having a lower fineness (T=15 and 17 den) and with which the cover/core ratio is lower. 17 den filaments show structural characteristics very similar to those of classical cellofibers.

In the case of insoluble (cotton-type) and soluble (filamentary) polyalcohol vinilic fibers, produced by Japanese firm Kuraray Co. Ltd., one may also observe structural differences among them.

Table 1
-OH group containing fibers

Fiber type	Density (g/cm^3)	Tenacity (cN/tex)	Maturity C_M	Δn	f_0	α_m
Cotton						
– soviet	1.5240	40.90	2.38	0.03099	0.418	38.90
– american	1.5370	42.10	2.49	0.03170	0.428	38.31
– sudanese	1.5432	44.02	2.62	0.03415	0.461	37.01
Viscose						
– cellofiber "B"	1.4940	16.96	–	0.0130	0.236	45.88
– polynose	1.5380	38.84	–	0.0365	0.663	28.68
Viscose filaments						
– 11 den	1.5102	21.09	–	0.01440	0.261	44.91
– 15 den	1.5024	18.52	–	0.01389	0.252	45.23
– 17 den	1.4970	17.82	–	0.01152	0.209	46.88
Polyalcohol vinyl						
– insoluble "B"	1.291	49.05	–	*cover* 0.0488 *core* 0.0253	–	–
– soluble 75/25 den	1.269	39.08	–	0.0146	–	–

Table 2
Textured PET fibers

Type	Texturation technology	Δn	ρ_d (g/cm^3)	I_c (%)	f_{0cr}	f_{0am}
167/32	clasic	0.1881	1.384	41.72	0.738	0.750
	SET	0.1703	1.379	37.51	0.666	0.670
150/32	SET	0.1829	1.381	39.32	0.722	0.728
110/32	clasic	0.1891	1.375	34.13	0.750	0.733
	SET	0.1683	1.373	32.43	0.677	0.645
76/32	clasic	0.1782	1.380	37.85	0.710	0.718
	SET	0.1636	1.376	34.56	0.686	0.657

In insoluble fibers, by reticulation performed with formic aldehyde for the fiber's "stabilization", as well as by advanced drawing, a cover/core structure is formed, inducing, too, an increase of crystallinity (I_c=55%, determined by RX diffraction). The cover's birefringence being of 0.0488 and of the core's of 0.0258, the value of total birefringence is of 0.0409.

Soluble filamentary fibers have a less compact structure and a lower crystalinity, as compared with insoluble fibers (I_c=45%); also, in the absence of a cover/core type structure, the general orientation is more reduced (Δn=0.01462).

Such a structure permits the yarn's solubilization in hot water, when this is employed together with a wool yarn for the obtainment of woven fabrics having also a reduced volume.

In the case of polyethylenterephtalate-type synthetic fibers, textured through different technologies, optical birefringence conveys the structural modifications intervening with the SET-system texturation as compared with classical texturation, From Table 2, one may observe that, in the SET system texturation, a "destructuration" of the fibers occur, regardless of their type, which is evidenced by the decrease of general birefringence. Such modifications have been also evidenced by measurements of density (the method of density gradient column) and of crystallite orientation factor (the method of RX diffraction).

The observation to be made refers to decrease of density and of the crystallinity index (as determined by the density method) for all types of fibers textured by the SET system.

Modifications of the morphological structure are clearly evidenced by the significant differences of birefringence values, as well as of those of the amorphous phase orientation factor.

3. Conclusions. Optical birefringence constitues a rapid and efficient method for estimation of some structural modifications that may occur as a result of some treatments or processins. Thus, it permits a quick intervention at a technological level, for the "regulation" of the yarn's structure, as compared with the physico-mechanical characteristics had in view, in the case of chemical fibers.

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BIREFRINGENŢA OPTICĂ – METODĂ DE APRECIERE A STRUCTURII MORFOLOGICE A FIBRELOR TEXTILE

(Rezumat)

În lucrare sînt prezentate rezultatele cercetărilor în ceea ce priveşte aplicarea birefringenţei optice pentru caracterizarea structurii morfologice a fibrelor textile.

S-au luat în studiu mai multe categorii de fibre, naturale celulozice, artificiale şi sintetice, obţinute prin diverse tehnologii, iar rezultatele birefringenţei optice au fost corelate cu alte determinări experimentale, precum: densitate, indice de cristalinitate, factor de orientare, tenacitate.

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TEXTILE. PIELĂRIE

POSSIBLE UTILIZATIONS OF POLYALCOHOLVINYLIC FIBERS, BY CHEMICAL MODIFICATIONS, AS BIOMATERIALS

BY

V. BLAŞCU, SEVERIAN DUMITRIU and CRISTOFOR I. SIMIONESCU

1. Introduction. Polyvinylic alcohol (PVA) is a polyhydroxylated polymer whose chemical structure may be modified in various ways by analogous polymer reactions.

PVA soluble or partially soluble fibers may be modified by chain reactions, occurring especially in amorphous regions.

The scope of the present study was retardation of some drugs on employing soluble or partially soluble PVA fibers as support.

It is generally known that drug retardation is mainly achieved on natural or synthetic macromolecular compounds, being accompanied by formation of covalent or ionic bonds.

Selection of the support is essential if considering the requirements it has to meet, namely: biocompatibility, reactivity, the capacity to release the drug, in pre-established doses, where and when necessary. Having all these in view, derivatives of cellulose, starch, xanthan, other mucopolysaccharides, have been investigated [1-6].

Out of the range of synthetic polymers, polyvinyl alcohol, acrylamide and vinyl pyrrolidone copolymers have been largely employed in reactions of drug retardation [7-10].

The reaction rate and yield of the micromolecular substance coupling on the PVA fiber support are lower than in the situations employing PVA powder, which is due to the biphasic crystalline-amorphous structure of the fiber, the amount of active substance retained in the fiber leading to satisfactory practical results.

2. Experimental. Coupling of the nalidixic acid and nitrofural on polyalcohol vinylic fibers has been achieved in the presence of dicyclohexylcarbodiimide as activator and 4-pyrrolidonepyridine as catalyst.

The nalidixic acid is an antibacterial agent active towards Gram-negative germs, its structure rendering it more active, especially in infections with germs resistant to other drugs [11].

Nitrofural is a strong bacteriostatic and bactericide in staphylococcic and streptococcic infections [12].

The results of coupling the nalidixic acid on polyvinyl alcohol with molecular weight=18,000 and 98% content of OH groups have been discussed elsewhere [13].

As a result of the crystalline-amorphous structure of polyvinyl alcohol as fiber, and of the partial blocking of the hydroxylic reactive groups, the esterification reaction of the nalidixic acid and that of additional reticulation of the fiber by means of nitrofural occur at lower yield.

Experimental results have demonstrated that the coupling reactions are influenced by: the PVA/nalidixic acid and PVA/nitrofural, respectively, the reaction time, the volume of dimethylformamide utilized as reaction medium.

In order to establish the optimal parameters of the reactions and, also, to know how they influence the process, a series of experiments have been performed, according to a centered, rotatory, composite, second order program [14].

The values of the reaction parameters (independent variables) have been coded as listed in Tables 1 and 2.

Table 1

Real and coded values of nalidixic acid-PVA reaction parameters

Real variable	Coded variable				
	−1.682	−1	0	1	1.682
PVA/nalidixic acid (mol/mol), x_1	0.4	0.6	0.72	0.9	1
Time (h), x_2	10	22	34	52	76
Volume of DMF (ml), x_3	15	18	29	38	49

Table 2

Real and coded values of nitrofural-PVA reaction parameters

Real variable	Coded variable				
	−1.682	−1	0	1	1.682
PVA/nitrofural (mol/mol), x_1	0.5	0.66	0.80	0.91	1
Time (h), x_2	9	15	31	37	43
Volume of DMF (ml), x_3	10	17	25	34	44

Corelation of the amount of nalidixic acid and coupled nitrofural, with the parameters taken into consideration, may be obtained with an equation of the following type:

$$Y = a_o + a_i x_i + a_{ij} x_i x_j \quad i \leq j, \qquad \text{where :}$$

y – amount of nalidixic acid, and of nitrofural respectively, in the reaction product
x_i, x_{ij} – variables representing the parameters taken into consideration
a_i, a_{ij} – regression coefficients

The regression coefficients of the above-mentioned equation have been established by the multiple regression method, on processing the experimental results on a Felix C-256 type computer, with a DOS operating system.

When employing the dicyclohexylcarbodiimide-4-pyrrolidonopyridine system, dicyclohexylcarbodiimide acts as activator, while 4-pyrrolidonopyridine as catalyst.

IR spectral analyses of the reaction products evidence ester formation (in the IR spectra, the absorption characteristic to the esteric group for the nalidixic acid coupled to PVA appears, to the etheric bridge respectively, the absorption specific to the dietheric group, for the nitrofural coupled to PVA).

The dependence of the amount of coupled nalidixic acid on the reaction parameters is described by the following equation (in coded system):

$$Y = -0.3x_1 + 0.168x_2 + 0.085x_3 + 0.171x_1^2 + 0.12x_1x_2 + 0.067x_1x_3 +$$

$$+0.0168x_2^2 + 0.006x_2x_3 + 0.034x_3^2 + 1.11$$

The dependence of the amount of coupled nitrofural on the reaction parameters is described by the following equation (in coded system):

$$Y = -0.2x_1 + 0.151x_2 + 0.077x_3 + 0.165x_1^2 + 0.117x_1x_2 + 0.062x_1x_3 +$$

$$+0.0159x_2^2 + 0.0057x_2x_3 + 0.032x_3^2 + 0.96$$

The Y value has been calculated with a standard deviation of 0.38% and a confidence threshold of over 99.9% (the "F" test evidences a value of 5.72 at 9 variables and 19 variance, which corresponds to a significance test P=0.001, determining finally the confidence threshold of 99.9%).

The multiple correlation coefficient and the "F" factor, having values of 0.915 and 5.72, respectively, indicate that the above equations describe properly the dependence of the amounts of micromolecolar substances coupled on PVA, in the reaction parameters.

Particularization of two of the regression equation variables in the center of the experimental domain or in any other point of it offers information on the influence of the third one upon the reaction.

Working within a time interval of 30-70 hours, the amount of nalidixic acid increases continuously, nevertheless, without recording a maximum. Thus, the observation may be made that, with longer durations, higher and higher esterification yield may be possibly obtained.

The regression equation permits drawing of some interesting conclusions upon the correlated influence of the reaction parameters. Analysis of the constant level curves in the experimental time PVA/reactant ratio plane evidences that the efficiency of the coupling reaction is higher when employing lower PVA/reactant ratios and times of reaction between 50 and 60 hours.

High yields may be also obtained when applying longer durations and higher dilutions, which is indicative of the importance of concentration values expressed as conformational changes of the macromolecular chains.

The experimental program applied and the results obtained for the two systems, namely PVA/nalidixic acid and PVA/nitrofural, are listed in Tables 3 and 4.

Table 3

Experimental program applied and results obtained for the PVA/nalidixic acid system

Nr.	Coded variable			Esterified nalidixic acid, %	
	x_1	x_2	x_3	real	calculated
1	−1	−1	−1	14.01	13.60
2	1	−1	−1	6.67	5.92
3	−1	1	−1	14.86	13.71
4	1	1	−1	15.20	14.57
5	−1	−1	1	12.30	10.94
6	1	−1	1	11.31	10.20
7	−1	1	1	14.24	13.06
8	1	1	1	12.85	13.12
9	−1.682	0	0	15.68	16.23
10	1.682	0	0	9.41	10.64
11	0	−1.682	0	8.67	9.01
12	0	1.682	0	11.62	9.85
13	0	0	−1.682	7.43	8.77
14	0	0	1.682	10.10	11.42
15	0	0	0	9.32	8.89
16	0	0	0	9.22	8.89
17	0	0	0	9.40	8.89
18	0	0	0	9.35	8.89
19	0	0	0	9.30	8.89
20	0	0	0	9.47	8.89

3. Conclusion. The coupling yields of the nalidixic acid and nitrofural to PVA as partially soluble thread, depend on the PVA/nalidixic acid ratio, the reaction time and DMF volume.

The reaction optimum parameters have determined according to a centered, rotatory, composite, second order program.

Table 4
Experimental program applied and results obtained for the PVA/nitrofural system

Nr.	Coded variable			Coupled nitrofural, %	
	x_1	x_2	x_3	real	coupled
1	−1	−1	−1	10.1	8.92
2	1	−1	−1	4.11	2.19
3	−1	1	−1	11.38	8.87
4	1	1	−1	8.27	6.70
5	−1	−1	1	12.43	11.32
6	1	−1	1	4.23	3.40
7	−1	1	1	12.10	11.00
8	1	1	1	10.09	9.21
9	−1.682	0	0	6.87	7.64
10	1.682	0	0	4.74	6.20
11	0	−1.682	0	4.67	5.89
12	0	1.682	0	8.97	9.52
13	0	0	−1.682	9.33	10.11
14	0	0	1.682	9.68	10.76
15	0	0	0	6.45	7.12
16	0	0	0	6.75	7.12
17	0	0	0	6.37	7.12
18	0	0	0	6.80	7.12
19	0	0	0	7.20	7.12
20	0	0	0	6.91	7.12

The role played by dicyclohexylcarbodiimide and 4-pyrrolidonopyridine in the reactions mechanism has been established.

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POSIBILITĂŢI DE FOLOSIRE A FIBRELOR POLIALCOOLVINILICE, PRIN MODIFICĂRI CHIMICE, CA BIOMATERIALE

(Rezumat)

În lucrare se prezintă fibre polialcoolvinilice (PVA) solubile şi parţial solubile cuplate, prin reacţii polimer-analoge, cu acid nalidixic şi nitrofural.

Se analizează rolul diciclohexilcarbodiimidei ca activator şi 4-pirolidonopiridinei, catalizator, în reacţii de cuplare.

Sînt studiate condiţiile care conduc la randamente maxime de cuplare a substanţelor medicamentoase organice pe fibre PVA solubile şi parţial solubile.

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RESEARCHES ON REDUCTION OF OLIGOMERS CONTENT FROM POLYESTERIC FIBERS

BY
IULIA BĂLĂU-MÎNDRU, DOINA-FELICIA TURCU and CARMEN OGHINA

1. Introduction. Polyesteric fibers contain 2-3.8% oligomers formed by polycondensation through PET synthesis. The presence of these low molecular substances, especially cyclic trimers is undesirable because of the difficulties which can appear in yarns and fibers manufacturing [1, 2].

The appearance of oligomers during dyeing is extremly unpleasant, particularly in dyeing at a temperature higher a 100°C; in this case a migration at fiber surface takes place, phenomenon which is accelerated by temperature and humidity.

The disturbances which appear during processing due to the existing oligomers are the following:

1. Deposits on pipes and dyeing equipment, obtaining a smaller efficiency caused by a higher current resistance.
2. Separations on dyed material, that can cause devilling, delustering and a non-uniform aspect.
3. Abrasion on the guidings of the yarns, resulting in friction modification.

Concerning the oligomers removing from polyesteric fibers, because of their reduced water solubility, it is difficult to disperse and wash them and the possibility of extracting them with organic solvents is too expensive.

In order to withdraw, even partially, the inconveniences due to the oligomers presence, an alkaline treatment of polyesteric yarns before dyeing was experimented.

2. Experimental Part. An alkaline treatment of polyesteric yarns (167/32 dtex) by means of different concentrations of NaOH solutions, at variable temperatures and periods, was carried out: NaOH solution concentration = 0.5, 1, 2, 3 g/l; temperature = 100, 110, 120°C; time = 15, 30 min.

The results presented in Fig. 1 show the oligomers content of alkaline-treated yarns in comparison with that of non-treated yarns.

A decrease in the content of oligomers which were extracted from the yarn, with temperature and time increase can be seen in Fig. 1.

The same effect was put into evidence by electron microscopy patterns. One can observe removal of oligomers from the surface of the alkaline-treated yarns in comparison with thermotreated yarns in aqueous medium in the same conditions (blind sample), (Fig. 2).

It is known that the alkaline treatment of PES yarns can influence the physico-mechanical characteristics, [3, 4]. Table 1 shows their variation depending on treatment conditions as compared with non-treated yarns.

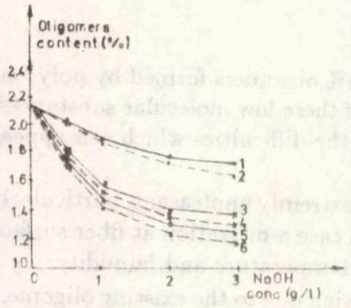

Fig. 1.– The influence of treatment concentration, temperature, period upon oligomers content; treatment at: 100°C, 15 min. (*1*); 100°C, 30 min. (*2*); 110°C, 15 min. (*3*); 110°C, 30 min. (*4*); 120°C, 15 min. (*5*); 120°C, 15 min. (*6*);

Table 1

Physico-mechanical characteristics of alkaline-treated and non-treated PES yarns (167/32 dtex)

Nr.	NaOH (g/l)	Time (min.)	Temp. (°C)	Title (dtex)	Elong. (%)	Tenacity (cN/dtex)
1	0.5	15	100	180.2	20.6	4.45
2	0.5	30	100	196.8	20.0	4.40
3	0.5	15	110	194.0	21.5	4.40
4	0.5	30	110	190.0	19.5	4.38
5	0.5	15	120	180.0	19.3	4.35
6	0.5	30	120	180.0	19.0	4.32
7	1.0	15	100	199.8	21.2	4.43
8	1.0	30	100	181.1	22.3	4.40
9	1.0	15	110	185.3	22.1	4.40
10	1.0	30	110	195.6	22.0	4.39
11	1.0	15	120	196.1	17.9	4.35
12	1.0	30	120	193.4	18.9	4.30
13	2.0	15	100	187.8	21.7	4.40
14	2.0	30	100	180.0	21.5	4.33
15	2.0	15	110	185.5	20.6	4.25
16	2.0	30	110	190.0	19.3	4.18
17	2.0	15	120	180.0	18.3	4.22
18	2.0	30	120	196.6	20.8	4.11
19	3.0	15	100	190.2	19.7	4.22
20	3.0	30	100	190.0	21.1	4.18
21	3.0	15	110	181.2	20.7	4.13
22	3.0	30	110	182.4	20.8	4.14
23	3.0	15	120	180.0	18.6	4.12
24	3.0	30	120	181.3	19.5	4.10
25	non-treated yarn			197.3	22.5	4.50

A slight decrease of physico-mechanical characteristics, especially tenacity, can b observed, respecting the tolerable modification field.

On this basis, one can find an optimum treatment method in the following conditions: NaOH concentration = 2 g/l, temperature = 110°C, time = 30 min., which

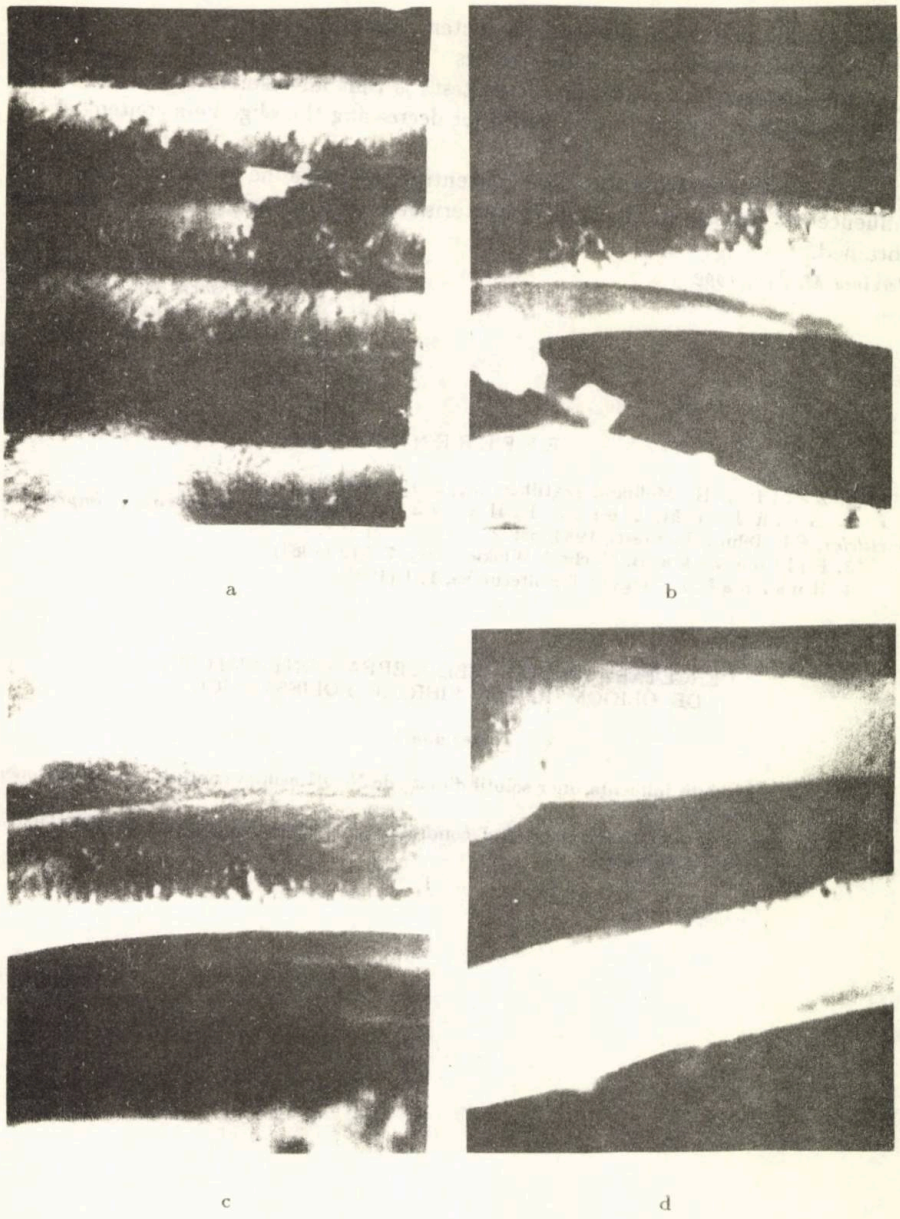

Fig. 2.– SEM photographs of the surface of PES fibers. a) blind sample; b,c,d) alkaline treated fibers at 110°C, 30 min., 0.5 g/l NaOH (b), 1 g/l NaOH (c), 2 g/l NaOH (d).

determine the reduction of oligomers content simultaneous with the maintenance of fiber physico-mechanical characteristics.

3. Conclusions. A conclusion of the tests is that an alkaline treatment of the PES fibers before dyeing is very useful for decreasing the oligomers content of the yarn.

The treatment conditions – low concentration of alkaline solutions – have little influence on physico-mechanical characteristics, thus a yarn protection is being obtained.

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CERCETĂRI PRIVIND REDUCEREA CONŢINUTULUI DE OLIGOMERI DIN FIBRELE POLIESTERICE

(Rezumat)

Lucrarea prezintă influenţa unor soluţii diluate de NaOH asupra conţinutului de oligomeri din fibrele poliesterice.

În acelaşi timp s-a studiat şi efectul condiţiilor de tratare asupra proprietăţilor fizico-mecanice ale fibrelor poliesterice.

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INTERACTION DE LA FIBROÏNE AVEC LES SELS DE DIAZONIUM

PAR
SAVEL IFRIM

1. Introduction. La soie naturelle est un produit biologique, avec une structure chimique macromoléculaire, de la classe des protéines, sécrétée par le ver-à-soie, l'espèce Bombyx mori. La production de la soie naturelle dans les buts pratiques est connue depuis plus de 4000 années, la patrie de la première production étant la Chine [1].

À l'exception des deux protéines composantes, la fibroïne et la séricine, la soie naturelle contient de petites quantités d'autres substances, à savoir: graisses, cires, pigments, produits minéraux, dans un pourcentage qui ne dépasse pas 2-3%.

La partie principale de la fibre de soie, la fibroïne constitue la matière protéique ayant une importance pratique remarcable, surtout pour l'industrie textile. La fibroïne représente le fil de soie naturelle proprement dit, se trouvant en proportion de 70-80% du poids brut de la soie nondégommée [2].

Il y a une large différénce entre les propriétés physiques et chimiques de la séricine et de la fibroïne, et ces propriétes expliquent l'éloignement relativement facile de la séricine. On connaît que seulement la séricine se dissout totalement dans une solution de savon à l'ébullition, ce qui constitue le principe du dégommage de la soie. Dans ces condition la fibroïne n'est pas dégradée.

2. Partie théorique. La fibroïne a une structure chimique polypeptidique très complexe, étant constituée d'un nombre de minimum 15 α-aminoacides enchaînés [3]. Par hydrolyse totale de la fibroïne, les acides aminiques composants se mettent en liberté et les déterminations quantitatives effectuées sur l'hydrolisant ont établi que la proportion entre ces acides aminiques est très différente: ainsi la glycine se trouve dans un pourcentage de 42,8%, l'alanine 33,5%, tandis que l'histidine se trouve dans un pourcentage de 0,5-0,6% et la cystéine présente seulment des traces, de sorte que dans la structure macromoléculaire de la fibroïne les ponts cystiniques manquent entièrement [4].

Il faut souligner le fait que les acides aminiques contenant des noyaux aromati-

ques se trouvent dans la fibroïne dans un pourcentage assez élevé. On a établi que la thyrosine représente 12,9% par rapport à la masse de la fibroïne, la phénylalanine 3,4%, le tryptophane approximativement 1% et la histidine 0,5-0,6%. Il en résulte qu'un pourcentage de 17,5-18% de la masse de la fibroïne est constituée d'acides aminiques, ayant des noyaux aromatiques dans leur structure chimique.

On a montré dans un travail récent [5] que chacun d'entre les acides aminiques indiqués plus haut, peuvent donner des réactions de substitution électrophiles, donc ils pourront copuler avec les sels de diazonium en formant de colorants azoïques. Ainsi comme la kératine de la laine peut servir comme composant de copulation, également la fibroïne, qui contient un pourcentage encore plus élevé d'acides aminiques ayant des noyaux aromatiques, pourra être utilisée comme composant de copulation. Donc par traitement avec des sels de diazonium, dans certaines conditions, la soie naturelle sera colorée en différentes nuances, dépendentes de la structure chimique du composant diazotable.

Les déterminations röntgenographiques ont montré que la fibroïne contient dans le filament naturel un degré élevé de cristalinité, donc les chaînes polypeptidiques sont orientées, sont empaquetées régulièrement, ce qui détermine l'apparition dans les filaments de la soie naturelle des régions semblables aux cristaux [6]. Ne manquent ni les régions amorphes dans la fibroïne, où les chaînes polypeptidiques sont moins orientées ou même désordonnées. Il faut mentionner le fait que, soit dans les régions cristallines, soit dans les régions amorphes, les chaînes polypeptidiques ne sont pas assemblées par liaisons transversales, elles ne possèdent pas de ponts cystiniques, donc ne sont pas réticulées. Mais cette structure chimique permet facilement la pénétration des petites molécules parmi les chaînes polypeptidiques, telles que les molécules de l'eau, et cette pénétration détermine la croissance du diamètre du filament, en apparaissant le gonflement. Ce gonflement se produit aussi dans les solutions alcalines, mais à basse température, quand la fibroïne n'est pas détruite [7]. Le gonflement du filament de la fibroïne favorise également la pénétration des autres particules, comme sont les cations de diazonium. Par substitution électrophiles sur les noyaux aromatiques des acides aminiques indiqués plus haut et qui sont enchaînés dans la macromolécule de la fibroïne, les cations de diazonium grefferont sur cette macromolécule. De cette manière apparaîtront des colorants azoïques incorporés ou bien enchaînés dans le filament de la soie naturelle.

3. Partie expérimentale. Les recherches antérieures effectuées par nous dans le laboratoire ont montré sans doute que parmi les acides aminiques composant des fibres proteiques, seulement la thyrosine, la phénylalanine, l'histidine et le tryptophane peuvent copuler avec les sels de diazonium formant des colorants [5]. Les épreuves affectuées sur les autres acides aminiques n'ont pas conduit à la même conclusion.

La pénétration et le greffage des sels de diazonium sur la macromolécule de la fibroïne sont favorisées si la fibre est gonflée. Dans ce but la soie naturelle a été introduite dans une solution aqueuse de 1% carbonate se sodium, ayant le pH=11 et a été maintenue 50-60 min. à la température du milieu ambiant. On utilise donc une propriété connue de la fibre pour aider le greffage des cations de diazonium sur

la macromolécule de la fibroïne.

Les sels de diazonium utilisées ont été obtenues par diazotation des quelques amines aromatiques bien connues comme produits diazotables, à savoir: l'acide sulfanilique, β-naphtilamine, benzidine et o-dianisidine.

Pratiquement, dans le laboratoire le traitment de la soie naturelle avec les sels de diazonium se réalise de la manière suivante: on introduit 1 g soie naturelle dégommée, fil ou tissu, dans 100 ml solution aqueuse de carbonate de sodium 1% et on la mentien 50-60 min., puis on refroidit la solution à 3-4°C.

Parallèlement on prépare les sels de diazonium des composants diazotables, prenant pour expérimenter 0,5 g de chacun, séparément. Le mode de travail pour diazoter est bien connu; on a utilisé toujours les quantités stoechiométriques d'azotite de sodium et d'acide chlorhydrique. Selon le perfectionnement de la réaction de diazotation, les solutions des sels de diazonium obtenues, chacunes séparées, on les introduit sur l'échantillon de soie naturelle, qui se trouve dans la solution de carbonate de sodium, refroidie de même à 3-4°C. Il se passe la réaction de copulation et par conséquence la soie devient colorée. Si l'échantillon de soie se mentient une durée plus prolongée (100-120 min.) dans la présence du sel de diazonium, la coloration de l'échantillon est plus intense, comme résultat de la pénétration des cations de diazonium vers l'intérieur de la fibre et du leur greffage en quantité plus grande sur la fibroïne.

La teinture de la soie peut être réalisée également par l'introduction de l'échantillon de soie dans la solution du sel de diazonium. Dans ce cas on retire l'échantillon de soie se trouvant dans la solution alcaline et sans être tordue, on l'introduit directement dans la solution du sel de diazonium. De cette manière la solution du sel de diazonium n'est plus diluée et la réaction de copulation se passe à vitesse augmentée; par conséquence l'échantillon de soie apparaît teintée dans une nuance plus intense.

On a obtenu les suivantes colorations:

- soie naturelle + acide sulfanilique diazoté.....orange
- soie naturelle + β-naphtylamine diazotée..... marron-rougeâtre
- soie naturelle + benzidine tetrazotée ..... jaune
- soie naturelle + ortho-dianisidine tetrazotée . . . beige

Pour vérifier la résistance des colorations, les échantillons teintés ont été soumis à l'extraction avec de la pyridine, à chaud; dans tous les cas la coloration des échantillons n'est pas modifiée. Cette épreuve montre que la teinture manifeste une bonne résistance, expliquée par le fait que les sels de diazonium sont attachés à la macromolécule de la fibroïne par liaisons covalentes, ce qui présente une importance pratique particulière.

4. Interprétation des résultats. La soie naturelle peut être peinte à l'aide de différentes catégories de colorants organiques, à savoir: colorants substantifs, acides, basique, complexables et réactifs [8]. Dans le cas de l'utilisation des ces colorants, la teinture se réalise à chaud ou à l'ébullition, en présence de différents produits auxiliaires: sulfate de sodium, sulfate d'ammoniaque, savon, acide acétique, agents d'égalisation etc. La rétantion des molécules de colorants par la fibroïne se réalise

à l'aide des groupements aminiques, carboxiliques, hydroxyliques, se trouvant dans la macromolécule de la fibroïne; par conséquence entre les molécules du colorant et la macromolécule de la fibroïne s'établissent de liaisons par paires d'ions (liaisons électrovalentes), liaisons d'hydrogène et seulement dans le cas de l'utilisation des colorants réactifs s'établissent des liaisons covalentes.

Dans le cas du procédé de la teinture de la soie avec les sels de diazonium, procédé qui est proposé dans ce travail, apparaîssent quelques aspects de nouveauté authentique: on n'utilise pas de colorants, ni produits auxiliaires et on ne consomme pas d'énergie, puisque l'opération se passe à froid. La teinture s'explique dans ce cas par réactions de substitution électrophile des cations de diazonium sur les noyaux aromatiques se trouvant dans la composition de la thyrosine, de la phenylalanine, de l'histidine et du tryptophane, en r'sultant de colorants azoïques, qui se trouvent inclus dans la macromolécules de la fibroïne. Dans ce processus de greffage des cations de diazonium sur la macromolécule de la fibroïne, cette dernière manifeste le rôle d'un composant de compulation. Cette possibilité de teindre la soie avec les sels de diazonium n'est pas signalée jusqu'au présent dans la litértature [9].

On peut interpréter qu'ils apparaîssent de colorants macromoléculaires fibreux, ayant la structure chimique de la figure 1, où Ar représente le reste d'amine diazotable.

Le procédé proposé présente plusieurs avantages:
– on peut utiliser un grand nombre d'amines aromatiques diazotables, qui par gréffage sur la fibroïne détermineront l'apparition de plusieurs nuances, de différentes couleurs.
– la réalisation pratique de la teinture est facile et ne demande pas une installation particulière.
– il ne nécessite pas une comsommation d'énergie pour élever la température de la flotte de teinture.
– ne sont pas nécessaires des substances chimiques auxiliaires.
– les teintures réalisées présentent une meilleure résistance, parce que les cations de diazonium sont attachés par liaisons covalentes à la macromolécule de la fibroïne.

Le procédé proposé peut être apprécié comme une possibilité de teindre à froid la soie naturelle, sans utiliser de colorants. Compte tennu du fait que dans la pratique on peut utiliser maintenant des sels de diazonium stabilisés, l'importance du ce procédé se met en relief.

On peut interpréter qu'il apparaît une possibilité plus économique de teindre la soie naturelle, matière première textile de grande finesse, ayant de nombreuses qualités et utilisations [10].

5. Conclusions. On étudie l'interaction des quelques sels de diazonium avec la soie naturelle, compte-tennu du fait que la fibroïne contient un pourcentage appréciable d'acides aminiques dans sa structure chimique, qui peuvent former des colorants par copulation avec les sels de diazonium.

On établit les conditions concrètes de gonfler les fibres de soie, ce qui favorise la pénétration des cations de diazonium vers l'intérieur de la fibre et leur fixation par la fibroïne dans un pourcentage plus elevé.

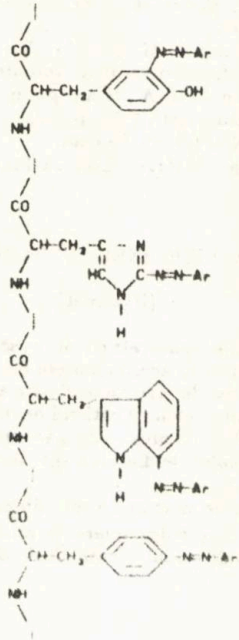

Fig. 1

Par greffage des cations de diazonium sur la fibroïne apparaissent des colorants macromoléculaires fibreux, la fibroïne ayant le rôle de composant de copulation. Les teintures obtenues de cette manière manifestent une meilleure résistance, parce que les sels de diazonium sont attachés à la fibroïne par liaisons covalentes.

On peut interpréter qu'il apparaît un procédé inconnu et plus économique de teindre à froid la soie naturelle.

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Institut Polytechnique, Jassy,
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INTERACŢIUNEA FIBROINEI CU SĂRURI DE DIAZONIU

(Rezumat)

Se studiază interacţiunea mătăsii naturale cu cîteva săruri de diazonium, urmărindu-se stabilirea unor condiţii practice de vopsire a acestei materii prime textile. Se ia în considerare faptul că fibroina conţine un procent ridicat de acizi aminici care au nuclee aromatice în structura lor şi deci vor da reacţii de substituţie electrofilă cu cationii de diazoniu.

Se foloseşte şi proprietatea fibrei de mătase de a se umfla în soluţii alcaline diluate, condiţie care favorizează pătrunderea cationilor de diazoniu spre interiorul fibrei şi reţinerea lor de către fibroină într-un procent mai ridicat.

Grefînd cationii de diazoniu pe macromolecula fibroinei, apar coloranţi macromoleculari fibroşi, fibroina avînd rol de componentă de cuplare. În modul acesta apar vopsiri mai rezistente, deoarece se formează legături covalente între cationii de diazoniu şi fibroină, iar procedeul de vopsire propus este mai economic.

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Secţia VIII
TEXTILE. PIELĂRIE

MÖGLICHKEITEN DER GEBRAUCHSVERÄNDERUNG VON NASS VERSPONNENEN FÄDEN DURCH VERDOPPLUNG DES VORGARNS IM RASTEL DER SPINNMASCHINE

VON

OLIMPIA MARCHIŞ, CARMEN CUZIC-ZVONARU und ALICE SIMION

Die zusammenfassenden Daten dieses Artikels verfolgen die Wirkung eines einfachen Eingriffs in der Endverarbeitungsphase der feinen Fäden vom Flachs-Typ auf die Charakteristiken der Fäden, die Steigerung der Produktivitätsindexe und auf Erweiterung der Auswahl der aus diesen Fäden hergestellten Erzeugnisse. Es wird gezeigt, wie die Verdopplung des Vorgarns im Rastel der Nassspinnmaschine die Herstellung beeinflusst. Für die Versuche wurden die drei herkömmlichen Gemische des Bereiches "Flachs" in Betracht gezogen, und zwar: 67% Flachs/ 33% PET; 50% Flachs/67% PET.

Tabelle 1 gruppiert prozentual die Steigerungen oder Senkungen von Parametern, die eine grosse Bedeutung für den Textilhersteller haben (Feinheitsgleichmässigkeit, Bruchlast, Bruchstreckung, Niveau der Brüche oder Risse). Die erzielten, als Grössen bedeutsamen Werte rechtfertigen die Opportunität der Methode.

Der verwendete Rohstoff bestand aus erstklassiger Flachsriste und Polyesterfasern vom Flachstyp. Die Verarbeitung der beiden Komponenten erfolgte nach einem klassischen technologischen Kammprozess, wobei drei Kategorien von Vorgarnen (entsprechend den drei Gemischen) hervorgingen. Das Vorgarn wurde in der Endphase der Spinnerei einfach oder doppelt gesponnen. Durch Verdopplung des Verzugs beim Spinnen erzielte man 24 Varianten von Fäden Nm20 (eine repräsentative Feinheit in der Flachs-Hanf-Abteilung).

Aus den Daten der Tabelle 1 geht hervor, dass auch die Temperatur des Wassers im Immersionsbehälter variiert wurde, und zwar bei 20, 30, 40 und 50°C.

Durch Anwendung einer einfachen und wirksamen Methode können in der Endspinnphase die Herstellungsfehler verbessert werden, die von einem Rohstoff bestimmt sind, der sich infolge seiner strukturellen und rheologischen Eigenheiten nicht vollkommen den Einschränkungen der Werkzeugmaschine und der gegebenen

Tabelle 1

Gemisch	Temperatur der Wassers	Strukturell-technologische Veränderungen (%) durch Verdopplung des Vorgarns			
		1	2	3	4
67% Flachs 33% PET	20	36,7	18,1	55,8	25,0
	30	41,8	15,3	54,2	33,3
	40	21,6	15,8	66,1	30,0
	50	32,2	16,2	53,3	26,3
50% Flachs 50% PET	20	23,3	27,9	59,6	7,6
	30	15,2	22,2	59,1	6,6
	40	15,0	26,6	55,2	15,3
	50	22,4	21,2	54,1	15,3
33% Flachs 67% PET	20	12,6	18,4	44,6	27,2
	30	8,6	23,8	42,1	26,6
	40	13,9	19,2	57,2	20,0
	50	8,5	17,8	54,8	25,0

1. Steigerung durch Verdopplung der Feinheitsgleichmässigkeit
2. Steigerung durch Verdopplung der Tenazität
3. Senkung durch Verdopplung der Bruchdehnung
4. Senkung durch Verdopplung der Anzahl von Brüchnen

Technologie im angewandten Prozess unterwerfen kann.

Es ergeben sich folgende wichtigen Schlussfolgerungen:

1. Unabhängig vom Gemisch verbessert sich die Gleichmässigkeit der Feinheit auf durchschnittlichen Abschnitten der Fäden, und zwar mit Werten zwischen 8,5...41,8%, wobei die wichtigsten Herabsenkungen beim Gemisch mit 67% Flachs auftreten.

Verfolgt man die Variation der Abweichung der durchschnittlichen Feinheit von der nominellen Feinheit, erscheint im untersuchten Aspekt ein besonders wichtiges Element für die Organisierung und Warnung der auftraggebenden Sektionen, bzw. beim Spinnen und Weben. *Die Abweichung von der Feinheit (bei Nm) hat ständig negative Werte* und wächst beim Steigen des Flachsanteils im Gemisch. Das bedeutet, dass die Fäden in der Gesamtheit der Partie dünner sind als die vorgeschlagenen, was Verbesserungen beim Voraussehen der strukturellen Charakteristiken des Gewebes sowie auch beim Festlegen der Regelungsparameter in der Webephase benötigt, vor allem weil es sich um die anspruchvollsten Flachsfäden handelt.

2. Die Tenazität wächst mit 15,3...27,9% (Tab.1 und Abb.1) im Versuch, gleichzeitig mit der Erhöhung dieses Parameters, verbessert sich auch seine Gleichmässigkeit. Diese günstigen Effekte können einer Gruppe von gleichzeitig wirkenden Bedingungen zugeschrieben werden:

– Einweichung der den natürlichen Komponenten begleitenden Gele, was das Gleiten begünstigt;

– Entladung der elektrostatischen Ladungen bei der synthetischen Komponen-

te, für die, unter den Bedingungen des trockenen Spinnens, desorganisierte Strukturen und Schwierigkeiten beim Spinnen auftreten;

– die energischere Einpackung der Fadenkomponenten durch Verdopplung des Verzugs, was zusätzliche, axial orientierte Zugkräfte verursacht, die eine direkte Wirkung auf die Homogenität der Strukturhaben. Die beiden Komponenten werden sich im Querschnitt homogen und nicht nach bestimmten Vorzügen verteilen, was das starke Anwachsen der Bruchlast und das Verringern ihrer Ungleichmässigkeit erklärt.

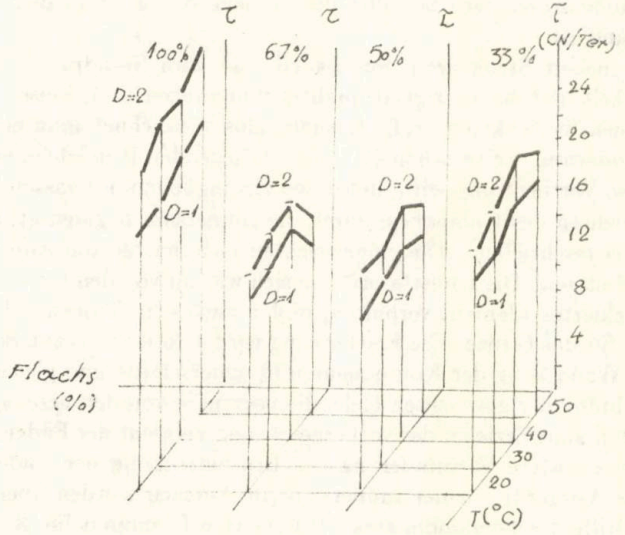

Abb. 1

Die angezeigte und analysierte Erscheinung hat um so stärker betonte günstige Wirkungen, je ausgeglichener das Spinngemisch ist. In diesem Fall beobachtet man, dass die Bedingungen der Fadenzusammensetzung aus dem Gemisch eine vorrangige Rolle spielen und nicht die Temperatur des Wassers aus dem Immersionsbehälter. So werden auch bedeutende wirtschaftliche Effekte vorausgesehen, und zwar über das Ersetzen des Überflusses an Wärmeträger durch die Verdopplung des Vorgarns vor der Immersion.

Der Effekt wird als günstig empfunden, sowohl in der Spinnphase, als auch durch die Grössen und Werte der nachträglichen Bearbeitungsphasen.

3. Die Temperatur des für die Immersion gebrauchten Wassers, die zwischen 20...50°C liegt, beweist durch die erzielten Werte, dass ihre Wirkung auf die untersuchten Parameter eine mässige ist.

Vorherrschend ist die Tatsache, dass je mehr die Temperatur steigt, bis zu 40°C, desto mehr die Parameter ihre Werte in positiver Richtung des gebrauchswertes verändern.

Bei den meisten Gemischen jedoch, unabhängig von der Verdopplung, senkt die Immersion in heisses, eine Temperatur von 50°C besitzendes Wasser ein wenig die ununterbrochen steigende Wirkung des Temperatureingriffs auf die Spinnfähigkeit.

Die Erhöhung der Fadentenazität bis zur Temperatur von 40°C findet ihre Erklärung in der Häufigkeitssteigerung der am übermolekularen Aufbau des Flachses durch die Wasserimmersion einbezogenen Wasserstoffbindungen. Bei höheren Temperaturen (um 50°C herum) kann man die leichte Verminderungstendenz der Tenazität dadurch erklären, dass die Wärme einen störenden Einfluss auf die Wasserstoffbindungen ausübt, die schwächer werden und sich schliesslich teilweise auflösen. Die hydrophobe Kunstfaser bewahrt ihre Tenazität, da sie in diese Erscheinung nicht verwickelt ist.

4. Die neuen Strukturen von Fäden, die vom Standpunkt der feinheitsgleichmässigkeit und der Festigkeit qualitativ überlegen sind, weisen auch betreffs Dehnung Eigentümlichkeiten auf. Ausnahmslos verzeichnet man eine ausgesprochene Verminderung der zwischen 42,1...66,1% liegenden Bruchdehnung (Tab.1 und Abb.2). Diese Verringerung wird, unter den Bedingungen des nassen Spinnens, der den Komponenten des Gemisches, durch die Immersion begünstigt, aufgezwungene Stellung zugeschrieben. Die eingeweichten Gele hatten die Aufgabe, die neue Struktur zu festigen. Die Kunstfasern, die sich wie ein von den Gelen in der Fadenstruktur blockiertes Element verhalten, bilden nach dem Trocknen Elemente "der Bewehrung" für das Ganze. Die Erscheinung wird gefördert bis zur Beseitigung der gruppierten Wanderung der Komponenten im Querschnitt und gleichzeitig bis zur Wiederanordnung der geweichten Gele, die vorrangig von den *verdoppelten* axialen Verzugskräften zum Erzielen der vorhergesehenen Feinheit der Fäden bedingt sind.

Die ausnahmslose Verminderung der Bruchstreckung der Fäden durch Verdopplung des Vorgarns vor der Immersion (im Versuch wurden über 7000 Einzelproben mit Hilfe des Dynamometers ZWIGG vom Kombinat für Kunstfasern Iasi getestet) beeinflusst den Stand der Risse (Brüche) nicht, dank der Verbesserung der Feinheitsgleichmässigkeit und der Zugfestigkeit. *Es erscheinen Möglichkeiten der zukünftigen Anwendung der neuen Fäden bei der Herstellung von Waren, die eine betonte Stabilität der Form verlangen, wie z. B. filtrierende Gewebe, Zeltbahnen, Schläuche, Nähzwirn, Lederwarenzubehör usw.* Hier ist die Anwesenheit der Kunstfasern in der Struktur wesentlich, die besonders zur Verbesserung der Gebrauchseigenschaften, wie Fäulnisfestigkeit, beitragen.

Durch Verdopplung gelangen die Fäden aus 50% Flachs/ 50% PET und diejenigen aus 33% Flachs/ 67% PET zu einer spezifischen Dehnung, die derjenigen der ähnlichen Fäden in reinem Zustand für den Bereich Flachs-Hanf nahekommt, was ein nicht zu verleugnender Vorteil und ein grosser Gewinn für Hersteller und Verbraucher von Fäden sind.

6. Durch Verdopplung des Vorgarns bei den Fäden werden die Verbesserung der Gleichmässigkeit von Feinheit und Festigkeit zusammen mit der erhöhten Bruchlast zur Verminderung der Anzahl von Brüchen (Rissen) führen. Diese Tatsache ist eigentlich ein von der Forschung verfolgtes Hauptziel. Die Daten der Tabelle 1 zeigen, dass die Zahl der Brüche, in die häufig gebrauchte Einheit, u. zw.

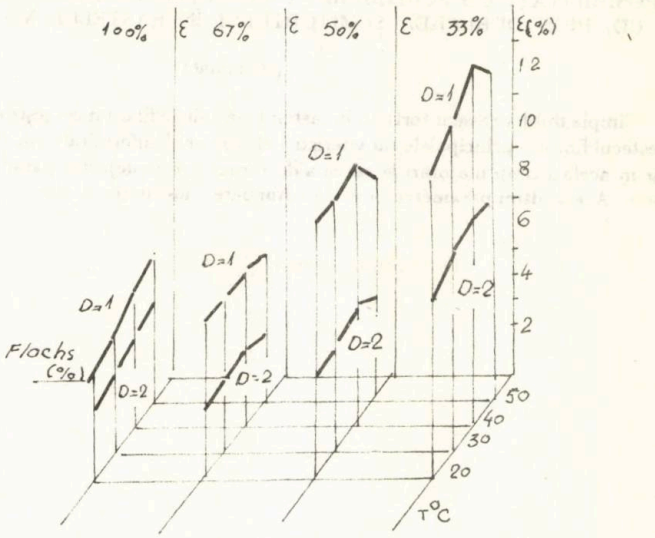

Abb. 2

Brüche/1000 Spindeln-Stunde, umgesetzt, zwischen weiten Grenzen, 6,6...33%, auftritt.

Besieht man sich die Grenzen der Bruchzahlverminderung, so ist es offensichtlich, dass Produktion und Produktivität steigen. Die Vorteile erscheinen grösser, wenn man bedenkt, dass es bei der Organisierung von Nassspinnereien für dünne Fäden vom Flachstyp und auch für die Verbraucher Schwierigkeiten gibt, dass man oft die Bedienungszone reduzieren und zusätzliches Personal einstellen muss, um den Herstellungsfluss nicht zu gefährden.

Die Opportunität der Einführung der Verdopplung in die Endphase des technologischen Nassspinnprozesses des Flachses wird von den Daten der Tabelle 1 unterstrichen.

Die Tabelle fasst prozentual die Abweichungen der qualitativen oder quantitativen Kennwerte der Fäden zusammen, die mittels der vorgeschlagenen Technologie hergestellt wurden, Dieses Verfahren verwendet die Verdopplung des Vorgarns beim Nassspinnen, im Verhältnis zu den entsprechenden spezifischen Elementen, die den gegenwärtigen Technologien auf weltweiter Ebene angehören.

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POSIBILITĂŢI DE SCHIMBARE A DESTINAŢIEI UNOR FIRE DE IN FILATE UD, PRIN DUBLAREA SEMITORTULUI ÎN RASTELUL MAŞINII DE FILAT

(Rezumat)

Simpla dublare a semitortului în rastelul maşinii de filat ud reuşeşte să corecteze – funcţie de amestecul fibros – principalele caracteristici ale firelor. Uniformitatea de fineţe îmbunătăţindu-se, apar în acelaşi timp majorări la sarcina de rupere (normale), dar paradoxal, scade alungirea la rupere. Acest ultim parametru permite schimbarea destinaţiei firelor.

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UNTERSUCHUNG DER MÖGLICHKEITEN, DAS FROTTIEREN IN DIE VORSPINNPHASE EINZUFÜHREN

VON
CARMEN CUZIC-ZVONARU

Die hauptkriterien, auf die sich die Wahl des Spinnsystems und der entsprechenden Variante des technologischen Prozesses stützt, sind: Erzielen der strukturellen Homogenität des Gemisches und Gleichmässigkeit der Fadenfeinheit. Bei den Bastfasern begrenzt das "Aussehen wie Leinen" den zweiten Parameter.

Als eine wertvolle ästhetische Charakteristik beeinflusst das "Aussehen wie Leinen" die in der Abteilung für Baumwolle und Wolle streng befolgten Gleichmässigkeitskriterien der Feinheit. Dieser Parameter darf die notwendigen Widerstandsgrenzen nicht überschreiten, vor allem weil es die Rede von Fäden mit sehr geringen Dehnungen ist. Die Festigkeitskriterien setzen das Entfernen aus dem Faden von sehr dünnen Zonen mit starken Spannungsansannlungen voraus, aber auch der zu verdickten und zu porösen Zonen, die aus weniger geteilten Komplexen und mit einer geringen Faseranzahl im Querschnitt gebildet werden.

Abgesehen von der Faserart, im Falle der feinen und extrafeinen Fäden, um die Qualitätsbedingungen zu erfüllen, wird empfohlen, in die Vorspinnphase den Drall der Faseraneinanderreihung einzuschliessen. Der angewandte Drall kann ein reeller (TR) oder ein falscher (TF) sein. Es hat sich erwiesen, dass auf der Nassspinnmaschine der Verzug der gedrehten oder frottierten Aneinanderreihung entschieden besser ist als der Verzug aus dem Band [1], [2], [3].

Zur Herstellung von feinen Fäden aus 100%-iger Flachsriste oder im Gemisch mit chemischen Fasern (nass gesponnen) wird vorherrschend die technologische Variante mit reellem Drall, bzw. mit Einschliessen des Fleiers in den Arbeitsgang, gebraucht. Diese Lösung wird *ausschliesslich* in Rumänien angewendet, und die Variante der chemischen Faserbehandlung vor dem Spinnen ist allgemein bekannt unter der Bezeichnung "entbastetes Vorgarn" (gekocht oder gebleicht).

Durch die konstruktive Lösung, das Funktionieren und den hohen Verbrauch an Arbeitsleistung wird der beim Verarbeiten der Büschel und ihrer Gemische gebrauchte Fleier zu einer "engen Stelle" im Vorbereiten der Kammflachsspinnereien

[4], [5], [6], [7].

Um die Produktivitätsindexe der Phase zu verbessern, sind dringende Eingriffe nötig, die dazu beitragen sollen, die Folgen der Einengung des Arbeitsgangs in der analysierten Zone zu verringern oder zu entfernen.

Im Rahmen der vorliegenden Arbeit wird eine neue unkonventionelle Technologie vorgeschlagen, und zwar mit Falschdrall in der Kammflachsspinnerei. Hier wird der Fleier durch ein Schlichtstreckwerk mit Frottiermuffen (Frotteur) (FROTOR) ersetzt. Das Vorgarn kann (wie auch das Halbgarn) roh, oder nachdem es chemisch behandelt wurde, verarbeitet werden. Die vorgeschlagene Technologie, ein Ergebnis langjähriger eigener Forschungen [8], [9], bietet der Bastfasernabteilung bedeutende Vorteile, so dass die Gesellschaft AMIT in ihr nachstes Fabrikationsprogramm den Bau rumänischer Geräte und Einrichtungen solchen Typs aufnimmt.

Die grosse Anzahl von Versuchen und Testwerten (die Teste wurden auf trockenem oder nassem Faserstoff durchgeführt) verlangte den Gebrauch eines Rechners. Man arbeitete mit der BASIC-Sprache [10]. Mit Hilfe des Testes T (Student) wurde die Wahrhaftigkeit der Regressionskoeffizienten geprüft und mit Hilfe des Testes Ficher die Angemessenheit. Das Programm sicherte das Erscheinen auf dem Display der überlagerten graphischen Darstellung, der Kurven für die gemessenen Werte und der Kurve für die Regressionsgleichung.

Tabelle 1 umfasst die Regressionsgleichungen (1)...(9), die wirkungsvoll und operativ in der Industrie angewandt werden können, wenn man einen neuartigen Faden mit gewissen auferlegten Charakteristiken in einem bestimmten Bereich einführen möchte.

Tabelle 1

Faden: 55 tex (Nm 18)	
$S_{50} = 8,1897 + 0,057834 \cdot \psi$ (N)	(1)
$S_{85} = 7,8111 + 0,078663 \cdot \psi$ (N)	(2)
$A_{50} = 24,5017 - 0,002004 \cdot \psi + 0,019675 \cdot \psi^2$ (mm)	(3)
Faden: 38 tex (Nm 26)	
$S_{50} = 5,1631 + 0,037881 \cdot \psi$ (N)	(4)
$S_{85} = 4,0279 + 0,035783 \cdot \psi$ (N)	(5)
$A_{50} = 29,9712 + 0,061772 \cdot \psi$ (mm)	(6)
Faden: 32 tex (Nm 35)	
$S_{50} = 4,1771 + 0,057258 \cdot \psi$ (N)	(7)
$S_{85} = 2,9167 + 0,043064 \cdot \psi$ (N)	(8)
$A_{50} = 19,6880 + 0,009838 \cdot \psi$ (mm)	(9)

Die Zeichen der Gleichungen aus Tabelle 1 haben folgende Bedeutung:

ψ – Grösse der Frottierung (7...18 Frottierungen/m);

S_{50} – Reisslast der Fasern aus Gemischen von 50% Flachs + 50% PET;

S_{85} – Reisslast der Fasern aus Gemischen von 85% Flachs + 15% PET;

A_{50} – Bruchstreckung der Fasern aus dem optimalen (und vorherrschenden) Gemisch, das in der Flachsindustrie gebraucht wird (50% Flachs + 50% PET).

Die vergleichende Analyse der Variation der durchschnittlichen Fadenreisslast nach Fadengemischen und – kategorien in Anhängigkeit von der Grösse der Frottierung, durch Einsetzen konkreter Daten, zeigt, dass die Ergebnisse sehr nahe aneinanderkommen, angefangen mit 9 Frottierungen/m, ein Wert, den wir zur Anwendung im Bereich Flachs-Hanf empfehlen. Die erzielten Fäden gehören, ohne Ausnahme, zur ersten Güteklasse. In vielen Fällen, infolge der Leichtigkeit, mit der das Wasser zwischen den Fasern der frottierten Anreihung durchdringen kann, wobei die Immersion eine stärkere Wirkung ausübt, ist die Qualität der Vorgarnfäden derjenigen der aus dem Kontrollhalbgarn erzielten Fäden überlegen.

Diese Methode erhöht die Produktivität stark, reduziert den Leistungsverbrauch und den Bedarf an Arbeitskraft.

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CERCETAREA POSIBILITĂŢILOR DE INTRODUCERE A FROTAJULUI ÎN FAZA DE PREFILARE

(Rezumat)

În filatura pieptănată de in, în faza de prefilare se foloseşte fără excepţie flaierul – cu debitare în semitort.

Se recomandă înlocuirea cu un frotor, care prin simplitatea soluţiei constructive şi viteza de lucru net superioară, reuşeşte să elimine acel „loc îngust" în preparaţia filaturii creat de flaier.

Prin soluţie propusă, calitatea firelor se menţine, în unele cazuri obţinîndu-se chiar îmbunătăţiri. Scopul principal este însă sporul de producţie spectaculos creat.

BULETINUL INSTITUTULUI POLITEHNIC DIN IAŞI
Tomul XXXVIII (XLII), Fasc. 1–4, 1992
Secţia VIII
TEXTILE. PIELĂRIE

ÉTUDE EN RMN DES SUBSTANCES D'ENCOLLAGE

PAR
MIHAI CIOCOIU

1. Introduction. L'une des plus modernes méthodes de mettre en évidence la composition chimique de certaines substances est la spectroscopie en résonance magnétique protonique ($RMN^{-1}H$) [1].

Des articles concernant la recherche en IR des produits d'encollage sont parus dans la littérature de spécialité [2, 3]. En ce qui concerne l'utilisation des spectres RMN, il n'y a aucune information.

On a adopté donc cette démarche dans la recherche, étant donnée la capacité de ceux-ci de mettre en évidence la composition chimique, ainsi que les cotes de participation des divers composants du produit analysé.

2. Conditions de travail. Les spectres $RMN^{-1}H$ ont été enregistrés sur un spectrophotomètre JEOL-C60 HL de production japonaise, à une fréquence de 60 Hz. On a utilisé des températures variées – entre 25°et 100°C – pour confirmer l'attribution des signaux ou pour la meilleure résolution des spectres. On a dissout les produits étudiés dans de l'eau ou dans du chloroforme deutérés, selon le cas.

On a étudié les produits présentés dans le tableau 1.

On a noté avec des lettres majuscules, sur les spectres des produits étudiés, les signaux qui représentent les produits comparants, qui ont du poids dans tous les cas. On a tracé aussi les ordonnées, notées avec (T), nécessaires aux calcul de la composition.

Tableau 1

N°	Dénomination commerciale	Firme productrice	Composition chimique	Présentation commerciale	Teneur en subst. sèche	pH
1	Vinarol ST	Hoechst R.F.G.	alcool polyvinilique	poussière blanche cristalisée	100	neutre
2	Aracet APV	I.C.Rîşnov Roumanie	alcool polyvinilique	poussière blanche amorphe	99,5	neutre
3	Gerol ACR	Soprosole France	copolymère acrilique	solution colloïdale	50	neutre
4	Medacril STE	ICPAO Mediaş Roumanie	polyacril	solution colloïdale	50	neutre

2.1. Les spectres des produits VINAROL et ARACET. Attribution des signaux. Les spectres présentés dans les figures 1 et 2 sont obtenus à partir de solutions en D_2OI. Pour mieux observer les signaux des protons neutres (signaux C et D) on a fait des enregistrements à 25°et à 70°(les températures respectives sont notées sur les figures).

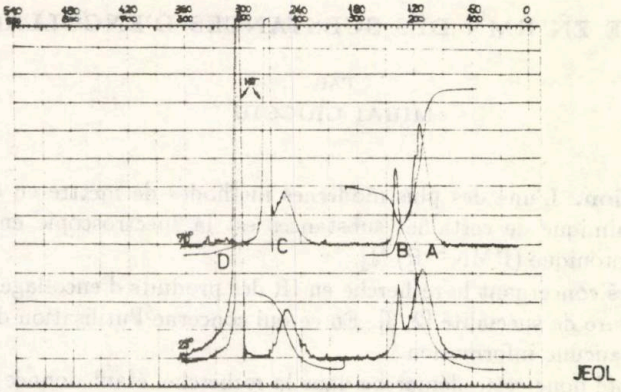

Fig. 1.- Le spectre RMN - VINAROL.

Une analyse, même superfielle, des spectres des deux produits étudiés, montre la similitude évidente des compositions chimiques. Les spectres sont parfaitment compatibles avec une structure d'alcool polyvinylique (PVAC) contenant des unités d'acétate de vinyle (VAC).

Attribution des signaux:

1,7 ppm (A): signal large provenant des protons méthyline des unités de vinylalcool (VAl) et de vinylacétate (VAc).

2,1 ppm (B): singlet provenant des protons méthyle des unités de vinylacétate (VAc).

4,1 ppm (C): signal large provenant des protons méthyliques des unités de vinylalcool (VAl).

5,2 ppm (D): signal large provenant des protons des unités de vinylacétate (VAc).

2.2. Détermination de la composition. On exécute cette opération sur la base de la mesure de l'intensité des signaux caractéristiques des deux types d'unités. Le rapport entre le nombre d'unités de vinylalcool (VAl) et le nombre d'unités de vinylacétate (VAc) est determiné comme il suit:

$$\frac{(VAl)}{(VAc)} = \frac{m}{n} = \frac{Ic}{Id} = \frac{Ic}{(I_{B/3})}$$

où: les unités de vinylalcool $(-CH_2-\underset{\displaystyle OH}{\underset{|}{CH}}-)_m$

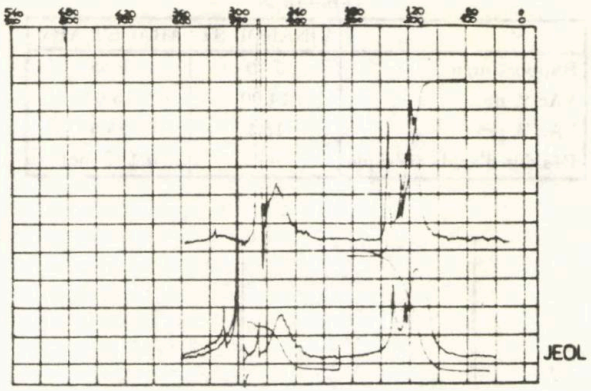

Fig. 2.- Le spectre RMN - ARACET.

les unités de vinylacétate $(-CH_2-\underset{\displaystyle O-CO-CH_3}{\underset{|}{CH}}-)_n$.

Le contenu molaire de vinylacétate est donné par la relation:

$$VAc\ \%\ \text{mol} = 100n/(m+n)$$

ou, en transformat:

$$VAc\ \%\ \text{mol} = 100\frac{1}{1+\frac{m}{n}}$$

Le contenu gravimétrique de vinylacétate est donné par les relations:

$$VAc\ \%\ \text{grav.} = 100\frac{86n}{44m+86n}$$

ou, en transformant:

$$VAc\ \%\ \text{grav.} = 100\frac{1}{1+\frac{44m}{86n}}$$

où m et n représentent le nombre de molécules de la chaîne de la macromolécule de polyvinylalcool et, respectivement, de vinylacétate.

Les déterminations réalisées sur la base des relations ci-dessus ont donné les caractéristiques présentées au tableau 2.

En analysant les données inscrites au tableau 2 on peut observer que le produit roumain est tout à fait similaire au produit importé à l'exception de quelques résidus d'acide acétique.

2.3. Les spectres RMN des produits GEROL ACR et MEDACRIL ST 8. Attribution des signaux. Les spectres présentés aux figures 3 et 4 indiquent l'identité des deux

Tableau 2

	VINAROL ST	ARACET APV
Rapport m/n	5.70	5.65
VAc % mol.	14.90	15.00
VAc % grav.	15.5	25.5
Résidus d'acide acétique	–	2.1 % mol

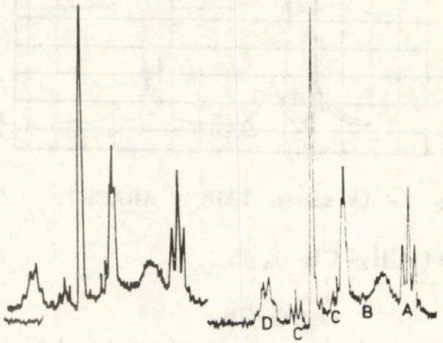

Fig. 3.– Le spectre RMN – GEROL (dissout en DMSO-D_6).

produits. Il faut préciser que ces produits sont des mélanges complexes de produits d'un poids moléculaire faible et de produits macromoléculaires.

Les spectres en $CDCl_3$ montrent que les produits contiennent approximativement 10% d'alcool éthylique. C'est le seul composant soluble dans du chloroforme. Les autres composants ont été dissouts en DMSD-D_6.

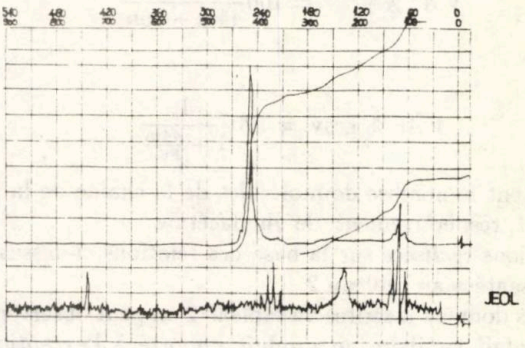

Fig. 4.– Le spectre RMN – MEDACRIL (dissout en DMSO-D_6).

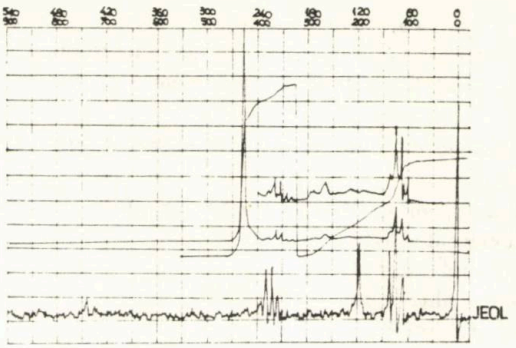

Fig. 5.– Le specre RMN – GEROL (dissout en $CDCl_3$).

Les spectres dans DMSO ne contiennent pas les signaux de l'éthanol puisque, avant la dissolution, l'échantillon a été séché pendant deux heures à 120°C.

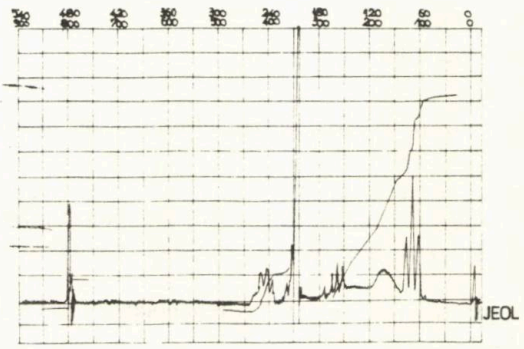

Fig. 6.– Le spectre RMN – MEDACRIL (dissout en $CDCl_3$).

Après avoir analysé les spectres des figures 3 et 6 on peut faire l'attribution suivante des signaux:

1,20 ppm (A): triplet provenant des protons méthyliques des unités d'acrylate d'éthyle (Ac + Et);

1,50 – 2,70 ppm (B): signal large provenant des protons CH_2 et CH de la chaîne du polyacylate d'éthyle (PAc + Et);

2,65 ppm (C): triplet provenant des protons CH_2-N de la chaîne de triethanolamine;

3,60 ppm (C): triplet (partiellement couvert par le signal du proton du OH) provenant des protons CH_2-O de la chaîne de triethanolamine;

4,95 ppm (D): quartet des protons methylène des unités d'acylate d'éthyle (AcrEt);

7,55 ppm (E): singlet aigu provenant, probablement, des protons aromatiques de l'acide térephtalique.

2.4. Détermination de la composition. Les deux produits contiennent:

(A): du polyacylate d'éthyle;

(B): de la triethanolamine;

(C): de l'acide térephtalique;

(D): de l'alcool éthylique,

ayant les formules chimiques suivantes:

$$(-CH_2 - \underset{\displaystyle O - CO - CH = CH_2}{\underset{|}{CH}} -)_m \qquad (A)$$

$$\left(N \begin{cases} - CH_2 - CH_2 - OH \\ - CH_2 - CH_2 - OH \\ - CH_2 - CH_2 - OH \end{cases}\right)_n \qquad (B)$$

$$(HOOC - C_6H_4 - COOH)_p \qquad (C)$$

$$(CH_3 - CH_2 - OH)_r \qquad (D)$$

Le rapport molaire entre les composants, déterminé sur la base des intégrales des signaux:

A:B:C:D = m:n:p:r = 1:1, 12:1, 18:2

On observe donc que les éléments de base des produits étudiés se rangent dans l'ordre de la cote de participation molaire: l'alcool éthylique et le polyacrylate d'éthyle.

Les produits B et C, respectivement la triethanolamine et l'acide térephtalique ont un rôle d'ingrédients.

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Institut Polytechnique, Jassy,
Chaire de Filature et Tissage

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STUDIU ÎN RMN AL SUBSTANŢELOR DE ÎNCLEIERE

(Rezumat)

În lucrare se prezintă un studiu în rezonanţă magnetică nucleară al compoziţiei substanţelor de încleiere româneşti prin comparaţie cu cele din import. Cercetarea în paralel permite punerea în evidenţă a calităţii produselor româneşti de încleiere.

BULETINUL INSTITUTULUI POLITEHNIC DIN IAŞI
Tomul XXXVIII (XLII), Fasc. 1–4, 1992
Secţia VIII
TEXTILE. PIELĂRIE

ÉTUDES CONCERNANT L'INFLUENCE DE LA VITESSE DU BRISEUR DU MÉTIER À FILER À ROTOR SUR LA LONGUEUR ET LA FORME DE LA FIBRE

PAR
DORIN AVRAM et MARIA AVRAM

1. Introduction. Pour la réalisation des fils sur le métier à filer à rotor, les fibres du ruban passent à travers les successions de phases qui ont comme but: l'ouvraison du ruban; le transport; le doublage; la mise en torsion.

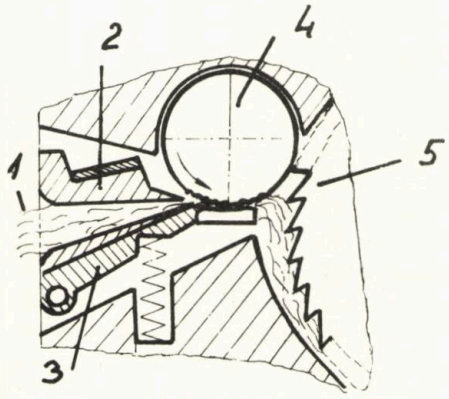

Fig. 1

Phase d'ouvraison se réalise dans un dispozitive présenté dans la fig. 1. Dans la zone d'alimentation, la section du ruban (*1*) se transforme de sa forme usuelle en une forme approximativement réctangulaire, dont la largeur est un peu inférieur à la largeur effective de la garniture du cylindre briseur (*5*) par l'intermediaire du condensateur (*2*). Le ruban est pressé par la plaque (*3*) et avance à l'aide du cylindre d'alimentation (*4*).

Dans la zone d'ouvraison, la garniture du cylindre briseur agit sur la frange du ruban de manière à en arracher successivement des grappes petites de fibres. Les dents de scie exercent une force sur les fibres pour vaincre les forces de cohésion, qui retienent les fibres.

Dans cette zone, l'action sur les fibres du cylindre briseur est déterminée par la vitesse et l'angle de travail des dents de la garniture. L'action du cylindre briseur peut être appréciée par la longueur moyenne des fibres, la forme et le degré de redressement de la fibre.

Parce que les caractéristiques des fils sont influencées par la longueur des fibres et la forme de la fibre, on a trouvé necessaire d'analyser les fibres qui quitent la zone d'ouvraison.

2. Partie expérimentale. On a utilisé une instalation composée d'un dispositif d'ouvraison présenté dans la fig.1 et un système d'aspiration des fibres. On a choisi deux types de fibres et on a changé la vitesse du briseur (3000, 5000, 7000, 10000 rotations par minute). Les fibres analysées ont été prises á la sortie du système d'aspiration et du ruban.

Les fibres utilisées sont:

- fibranne de 1,5 den et la longueur de 36 mm;
- polyester de 1,5 den et la longueur de 38 mm.

D'ailleurs pour avoir une comparaison êntre les résultats on a gardé la finesse du ruban (4g/m), la vitesse d'alimentation et le type de la garniture pour chaque type de fibre.

Pour chaque variante on a préparé les échantillons selon STAS 7638-66 et on a déterminé:

- la longueur dans l'état projeté (l_o) fig.2a;
- la longueur dans l'état tendu (l) fig.2b.

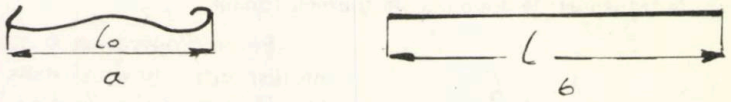

Fig. 2

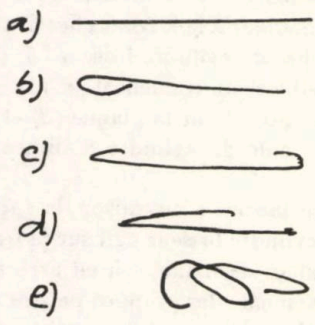

Fig. 3

A l'occasion de la mesure chaque fibre a été classée selon la forme dans les types suivants:

- fibre droite, fig.3a;
- fibre à crochet fig.3b;
- fibre à deux crochets fig.3c;
- fibre plinée fig.3d;
- fibre bouclée fig.3e.

Pour chaque variante on a suivi:

- le diagramme de distribution de la longueur des fibres dans l'état tendu fig.4 (fibranne) et fig.5 (polyester);
- on a calculé la longueur moyenne dans l'état projeté et tendu et le degré de redressement de la fibre (tableau 1);
- le pourcentage des fibres dans chaque type selon la forme (tableau 2).

3. Conclusions. D'après les résultats obtenues on rémarque une influence petite de la rotation du briseur sur la longueur moyenne (dans l'état tendu) par rapport à la longueur initiale ce que veut dire que le briseur raccourci peu les fibres dans la phase d'ouvraison.

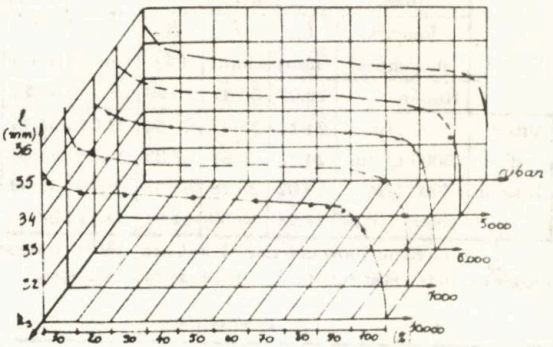

Fig. 4

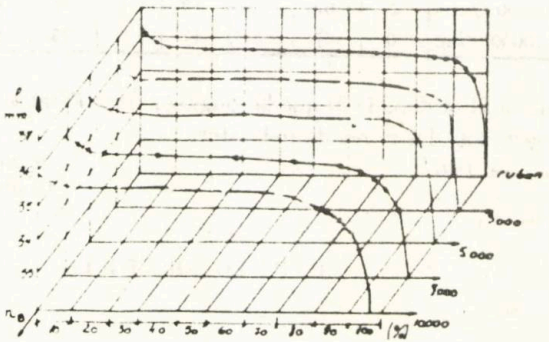

Fig. 5

On remarque que le dégré de redressement des fibres baisse par rapport à la valeur initiale en fonction de l'augmentation de la rotation du briseur. L'influence plus grande est remarqué pour les fibres de polyester que pour la fibranne.

En ce qui concerne la forme de la fibre on constate que par rapport à la fibre initiale on change beaucoup de forme, en augmentant le pourcentage des fibres à crochet. L'influence plus évidente est pour les fibres de polyester.

Donc on peut dire que l'augmentation de la vitesse du briseur influence plutôt

Tableau 1

	Types de fibres	Polyester			Fibranne		
	Valeurs moyennes	$\underline{l}_0$ (mm)	$\underline{l}$ (mm)	K (%)	$\underline{l}_0$ (mm)	$\underline{l}$ (mm)	K (%)
	Ruban	28,07	36,47	76,96	25,42	34,74	73,17
Vitesse du briseur	3000 t/min	24,11	35,47	67,64	23,01	34,75	66,21
	5000 t/min	24,12	35,82	67,33	24,95	34,89	71,51
	7000 t/min	23,02	35,78	64,33	21,76	31,80	68,42
	10000 t/min	21,98	35,50	61,91	24,71	34,61	71,39

$\underline{l}_0$ – longueur moyenne dans l'état projeté; $\underline{l}$ – longueur moyenne dans l'état tendu; K – degré de redressement.

Tableau 2

	Types de fibres	Polyester (%)					Fibranne (%)				
	Forme de fibre	Fig.3a	Fig.3b	Fig.3c	Fig.3d	Fig.3e	Fig.3a	Fig.3b	Fig.3c	Fig.3d	Fig.3e
	Ruban	51	25	3	15	6	54	28	9	4	5
Vitesse du briseur	3000 t/min	29	32	16	21	2	22	43	15	18	2
	5000 t/min	5	61	17	13	4	45	31	18	2	4
	7000 t/min	5	62	16	13	4	16	44	18	16	16
	10000 t/min	6	67	5	17	5	22	50	14	10	4

la forme de la fibre dans le fil que la longueur dans l'état tendu. Les fibres les plus endommagées sont les fibres de polyester.

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BIBLIOGRAPHIE

STUDII PRIVIND INFLUENŢA VITEZEI CILINDRULUI DE DEFIBRARE AL MAŞINII DE FILAT CU ROTOR ASUPRA LUNGIMII ŞI FORMEI FIBREI

(Rezumat)

Lucrarea tratează aspecte legate de influenţa vitezei cilindrului de individualizare de la maşina de filat cu rotor, asupra lungimii medii a fibrelor, coeficientului de îndreptare şi asupra formei fibrei, în cazul a două tipuri de fibre (celofibră şi poliester).

BULETINUL INSTITUTULUI POLITEHNIC DIN IAŞI
Tomul XXXVIII (XLII), Fasc. 1–4, 1992
Secţia VIII
TEXTILE. PIELĂRIE

COMPORTEMENT DES FILS TEXTILES AU RAYONNEMENT AU RAYONS ULTRAVIOLETS

PAR

MARIA AVRAM, DORIN AVRAM et MIRCEA PĂLĂMARU

1. Introduction. Les produits textiles par leurs destinations sont soumis à l'action des rayons solaires qui ont comme effect la destruction.

La destruction est realisée par l'action des rayons ultraviolets émis par le soleil sur les polymères synthétiques et artificiels. A cette réaction de destruction participe l'oxygène, l'humidité atmosphérique, les caractéristiques des fibres et le temps.

Les connaissances en ce qui concerne le comportement des fils sous l'action des rayons ultraviolets sont très utiles dans la conception des produits pour certains destinations.

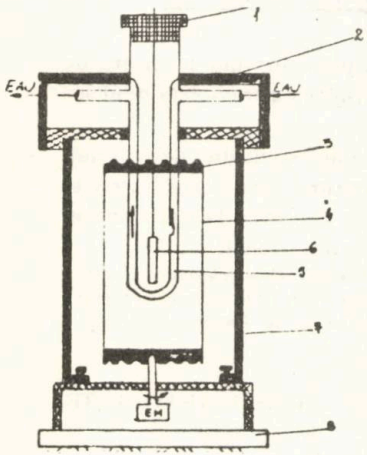

Fig. 1.– UV-1 FIRTEST

2. Installation utilisée. On a fait construire une installation pour rayonnement au rayons ultraviolets UV-1 FIRTEST – fig.1.

L'installation est composée d'une source de lumière ultraviolete (lampe type CFW-125W-220V)(*6*) qui est introduite dans un tube en verre de Pirex (*5*) à double parois qui servent à circuler de l'eau comme refraichissement et filtre pour les radiations à la longueur d'onde petites. Le tube en verre est fixé dans un couvercle métallique (*2*) à l'aide d'un bouchon (*1*). Le fil à tester est enroulé sur un suport métallique (*3*) qui peut être tourné à une petite vitesse. Tout cela s'introduit dans un cylindre métallique (*4*) argenté à l'intérieur, pour l'accroissement du processus de radiation.

3. Partie experimentale. On a choisi pour la radiation plusieurs types de fils, en cherchant l'influence de la duré du traitement, sur la résistence et allongement à la rupture.

Parce que le traitement a été fait dans les conditions speciales, on a utilisé une transformation entre le temps du traitement et le nombre de jours dans les conditions normales pendant l'été et l'hiver; ainsi, une heure de traitement corespond à 45 jours d'hiver et 1 jour d'été. Les valeurs obtenues sont présentées dans le tableau 1.

Tableau 1

Saison	Eté				Hiver			
Nombre d'heurs de radiation	8	16	24	32	8	16	24	32
Nombre de jours	8	16	24	32	360	720	1080	1440
Nombre d'années	–	–	–	–	0,98	1,97	2,98	3,94

Pour les fils testés on a obtenu les résutats présentés dans le tableau 2.

Tableau 2

Types de fils	Résistance (cN)					Allongement (mm)				
	Nombre d'heurs					Nombre d'heurs				
	0	8	16	24	36	0	8	16	24	36
45% WO + 55% PES	418,7	248	250	294	210	26	24	20	18	16
100% WO	103	96	97	101	102	10	10	8	10	13
100% coton	255	241	217	246	226	6	6	5	6	6
33% CO + 67% PES	172	165	106	92	112	6	6	5	5	6
100% LIN blanchi	1051	1031	1167	1083	1093	2,5	2,5	3,1	3,7	3,2

4. Conclusions. En fonction de résultats obtenus on peut dire que les fibres de laine, coton et lin se comportent bien à la radiation au rayons ultraviolets pour les périodes étudiées.

Le mélange des fibres naturelles avec le polyester manifestent une destruction par la diminution de la résistance et l'allongement à la rupture. Donc dans l'activité de conception des tissus il faut faire attention en ce qui concerne la paticipation des fibres de polyester pour les produits exposés beaucoup au soleil.

Reçue le 5 mai, 1992

Institut Polytechnique, Jassy,
Chaire de Filature et Tissage,
Chaire de Chimie Générale

COMPORTAREA FIBRELOR TEXTILE LA IRADIEREA CU RAZE ULTRAVIOLETE

(Rezumat)

Lucrarea tratează aspecte privind realizarea unei instalaţii pentru iradierea firelor textile cu raze ultraviolete. De asemenea se prezintă influenţa timpului de iradiere asupra caracteristicilor firelor funcţie de materia primă. Comportarea firelor la iradierea cu raze ultraviolete determină proiectarea structurilor ţesute pentru produsele expuse razelor solare.

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COMPUTER DESIGNING OF SEMI-DOUBLE FILLING-WOVEN FABRICS AS A FUNCTION OF WEIGHT (g/m^2) I. THE ALGORITHM OF CALCULATION FOR EQUAL THREAD COUNT IN THE FILLING

BY
GABRIEL CORNELIU CHINCIU and DANIEL CHINCIU

1. Introduction. Semi-double filling-woven fabrics are preferred to semi-double warp-woven fabrics due to their much simpler fabrication.

The algorithm worked out for their computer designing describes the calculation steps according to a logical dependence, quite simple to be programmed on any electronic device.

Description of such phenomena as total contraction and total average contraction, as well as the basic concept of the mathematical model represent the authors' original contribution [1], [2].

2. General Considerations. Semi-double filling-woven fabrics consist of two systems of the filling and warp one.

Calculation of weight [3], in g/m^2 for the finite fabric employs the formula:

$$M = \frac{D_{bi} \cdot T_{bi} + D_{bs} \cdot T_{bs} + D_u \cdot T_u}{100 - A_{mb}} \cdot \frac{100 \pm p}{100} \tag{1}$$

where: D_{bs}, D_{bi} – thread count of superior and, respectively, inferior filling yarns, expressed as ends per 10 cm; D_u – thread count of warp yarns, expressed as picks per 10 cm; T_{bu}, T_{bs} – linear density of superior and, respectively, inferior filling yarns, expressed as tex; T_u – linear density of warp yarns, expressed as tex; A_{mb} – total average contraction on all yarn systems, expressed as %; p – weight loss or weight addition during finishing, expressed as %.

Total average contraction is calculated with the relation:

$$A_{mb} = \frac{A \cdot A_{bm} + B \cdot A_{bm} + C \cdot A_u}{A + B + C} \tag{2}$$

where: A_u – contraction of warp yarns in processes of weaving and finishing, and:

$$A = D_{bs} \cdot T_{bs} \cdot (100 - A_u) \tag{3}$$

$$B = D_{bi} \cdot T_{bi} \cdot (100 - A_u) \tag{4}$$

$$C = D_u \cdot T_u \cdot (100 - A_{bm}) \tag{5}$$

A_{bm} – average contraction on filling systems.

These values are calculated with the following relation:

$$A_u = 100 - \frac{(100 - C_{tu}) \cdot (100 - C_{fu})}{100} \tag{6}$$

$$A_{bm} = \frac{D \cdot A_{bs} + E \cdot A_{bi}}{D + E} \tag{7}$$

where A_{bs} and A_{bi} represents contraction of superior and, respectively, inferior filling yarns, during weaving and finishing.

These parameters may be calculated by relations:

$$A_{bs} = 100 - \frac{(100 - C_{tbs}) \cdot (100 - C_{fb})}{100} \tag{8}$$

$$A_{bi} = 100 - \frac{(100 - C_{tbi}) \cdot (100 - C_{fb})}{100} \tag{9}$$

Coefficients D and E take the following values:

$$D = D_{bs} \cdot T_{bs} \cdot (100 - A_{bi}) \tag{10}$$

$$E = D_{bi} \cdot T_{bi} \cdot (100 - A_{bs}) \tag{11}$$

3. Designing of Semi-double Filling-woven Fabrics with an Alternance Ratio of the Yarns Systems 1 BS: 1 BI. Characteristics:

$$D_{bs} = D_{bi} = D_b \tag{12}$$

and:

$$T_{bs} = T_{bi} = T_b \tag{13}$$

Starting from the equality between the thread count and lineary density values of the two filling systems, the conclusion may be drawn, that the same relation of equality is established, as well, between their contraction values, in processes of weaving and finishing:

$$A_{bi} = A_{bs} = A_b \tag{14}$$

Contraction of the warp yarns is expressed by formula (6).

Total average contraction will be:

$$A_{mb} = \frac{2 \cdot F \cdot A_{bm} + G \cdot A_u}{2 \cdot F + G} \tag{15}$$

where:

$$F = D_b \cdot T_b \cdot (100 - A_u) \tag{16}$$

$$G = D_u \cdot T_u \cdot (100 - A_{bm}) \tag{17}$$

Under the above mentioned conditions, the fabric's weight is:

$$M = \frac{2 \cdot D_b \cdot T_b + D_u \cdot T_u}{100 - A_{mb}} \cdot \frac{100 \pm p}{100} \tag{18}$$

3.1. Designing through thread count modification. Parameters known: m, T_u, T_b. Parameters to be calculated: D_u, D_b.

Starting from the relation $(D_u/D_b = d)$, from which the equality $D_u = d \cdot D_b$ results, and replacing it in relation (18), the following relation is obtained for the calculation of fabric's weight:

$$M = \frac{D_b(2 \cdot T_b + d \cdot T_u)}{100 - A_{mb}} \cdot \frac{100 \pm p}{100} \tag{19}$$

while warp thread count with relation:

$$D = \frac{m \cdot (100 - A_{mb})}{2 \cdot T_b + d \cdot T_u} \cdot \frac{100}{100 \pm p} \tag{20}$$

$$D_u = d \cdot D_b \tag{21}$$

The calculated values will be rounded off so that the last figure should be either 0 or 5.

The established value of thread count will be subsequently employed for ckecking weight, by means of formula (19), and, by comparing it with the prescribed value, the limits of the accepted deviation should be settled.

3.2. Designing through thread count modification. Parameters known: m, D_u, D_b. Parameters to be calculated: T_u, T_b.

Starting from the relation $(T_b/T_u) = t$, from which the equality $T_u = (T_b/t)$, results and replacing it in relation (18), calculation of weight may be performed with the following formula:

$$M = \frac{T_b \cdot (2 \cdot t \cdot D_b + D_u)}{t \cdot (100 - A_{mb})} \cdot \frac{100 \pm p}{100} \tag{22}$$

Linear density the filling yarns is calculated from relation (22), by formula

$$T_b = \frac{t \cdot (100 - A_{mb}) \cdot m}{2 \cdot t \cdot D_b + D_u} \cdot \frac{100}{100 \pm p} \tag{23}$$

while linear density of the warp yarns may be obtained from relation:

$$T_u = (T_u/t) \tag{24}$$

The standard linear density values are considered, then recalculation of weight is made, with relation (22), the admitted deviation being subsequently established.

4. Conclusions

1. The algorithm proposed by the authors, quite simple, considers all necessary elements for the establishment of the basic parameters of a semi-double filling-woven fabric with equal values of the thread count.

2. For simplification of the algorithm, some new notions about contraction are introduced.

3. The algorithm is conceived to correspond to conditions of portability on PC-compatible computers or on any other type of electronic devices in any language of programmation.

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PROIECTAREA ASISTATĂ DE CALCULATOR A STRUCTURILOR ŢESUTE SEMIDUBLE DE URZEALĂ FUNCŢIE DE MASA ÎN g/m^2 I. ALGORITM DE CALCUL PENTRU DESIMI EGALE ÎN URZEALĂ

(Rezumat)

Algoritmul de calcul prezentat în lucrare corespunde, prin conţinut şi concepţie, condiţiilor de portabilitate pe calculatoarele compatibile PC, în orice limbaj de programare şi se referă la proiectarea ţesăturilor semiduble de bătătură cu desimi egale.

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ASPEKTE HINSICHTLICH DER WEBKANTENBILDUNG BEI DER STB-WEBMASCHINE

VON

IOAN CIOARĂ und LUCICA CIOARĂ

1. Einleitung. Das Gewebe als ebenes textiles hat zwei Kanten, die eine Reihe von verschiddenen Grundfunktionen erfüllen und die unter verschiedenen Bedingungen, entsprechend der angewandten Webtechnologie, erhalten werden.

Die wichtigsten Funktionen der Webkanten sind:

– Begrenzung und Konstanthaltung der Gewebebreite;

– Gewährleistung der notwendigen Festigkeit bei Beanspruchungen während des Web- und Zurichtungsprozesses;

– Gewährleistung einer bestimmten Ästhetik, entsprechend auferlegter Bedingungen des Handels.

Um diesen Funktionen gerecht zu werden, muss die Webkante folgenden Anforderungen genügen:

– gleiche Länge und Dicke wie der Gewebegrund;

– keine Roll- und Welltendenzen;

– sie muss so schmal wie möglich sein, um eine maximale Auswertung des Materials im Konfektionsprozess zu erlauben;

– kleinerer Fadenverbrauch bei dessen Ausführung;

– ausreichende Festigleit, damit sie nicht ausfasert bei den nachfolgenden Bearbeitungsprozessen.

Diese letzte Bedingung muss besonders bei den auf nichtkonventionellen Webmaschinen hergestellen Geweben eingehalten werden, weil man eine oder zwei falsche Webkanten erhält, da die Einführung des Schussfadens segmentenweise erfolgt. Auf solchen Maschinen beeinflusst der Typ des Kantenbildungsmechanismus entscheidend das Aussehen, die Struktur und die Ausfaserungsfestigkeit der Webkante, Auf den unkonventionellen Webmaschinen werden am meisten folgende hergestellt: Dreherkante, Umkehrenden, Klebekanten mit Bindemittel, Schmelzkanten, Kettenkanten.

Auf der STB-Webmaschine werden Webkanten mit umgedrehten Enden her-

gestellt, bzw. die Enden des Schussfadens werden in das folgende Fach simultan mit dem Schussfaden eingeführt und verdichtet, wodurch man eine saubere und gut verstärkte Kante erhält.

In der vorliegenden Arbeit werden einige kinematischen Bedingungen für den Funktionsmechanismus der Bildung der Kanten auf der STB-Webmaschine herausgestellt sowie die technologischen und strukturellen Vorgaben, die eingehalten werden müssen, um eine Webkante zu erhalten, die im grösstmöglichen Masse den erwähnten Anforderungen gerecht wird.

2. Kinematische Bedingungen. Es ist allgemein die tatsache bekannt, dass einer der komplexesten Mechanismen der STB-Webmaschine der Mechanismus zur Herstellung der Kanten ist. Er wird auf jeder Seite der Maschine montiert, und im Falle der Bearbeitung von Vielfachbreiten werden zusätzliche Kantenmechanismen in der mittleren Zone montiert. Der Mechanismus der STB-Webmaschine zur Kantenherstellung besteht aus dem Nadelmechanismus (Hakennadel), dem Fadenfangmechanismus und dem Regelsystem (Regler).

Zur Einführung der Enden der Schussfäden in das Fach führt die Nadel des Kantenbildungsmechanismus (Abb. 1) eine Bewegung aus, die aus Folgenden zusam- mengesetzt ist:

– Pendelbewegung des Hebels (*5*) der Nadel (*7*) um die Achse O_2. Diese Bewegung wird von der Zylindernocke (*1*) durch den Hebel (*3*) und die Führungen C_1 und C_2, die zu der Führunhsbahn (*4*) gehören (Abb. 1a), übertragen.

– Translationsbewegung der Nadel infolge der Nockenwirkung (*8*), die durch den Rollenhebel (*10*) und die Bolzen A auf die Unterlage übertragen wird. Die Nocken (*1*) und (*8*) sind auf der Welle (*2*) montiert, die die gleichmässige Rotationsbewegung von der Kurbenwelle im Verhältnis 1:1 erhält.

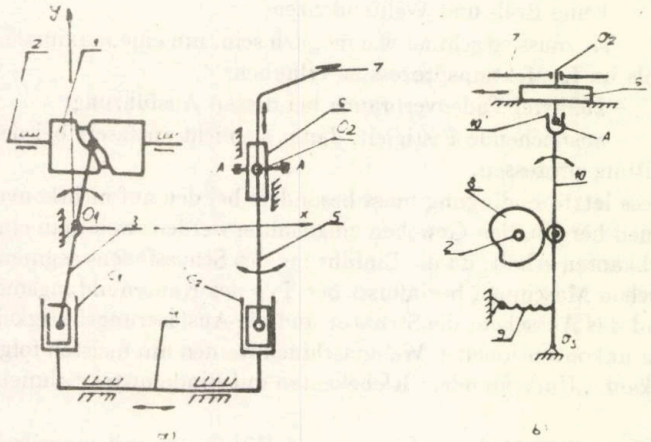

Abb. 1.– Nadelmechanism.

Auf experimentellem Wege wurde die Bahn der Nadel (Abb. 2) für einen Arbeitszyklus aufgezeichnet. Auf dieser Bahn, die eine ebene Kurve darstellt und die durch Kombination der beiden Bewegungen erhalten wurde, werden folgende Zonen unterschieden:

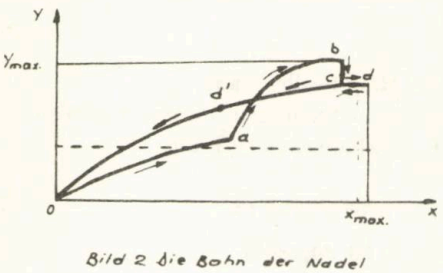

Abb. 2.– Die Bahn der Nadel.

(0-a) – entspricht der Pendelbewegung der Nadel im Hinblick auf den Austritt unter der Gewebeebene, wo sie sich während der Zeitdauer der Schwingbewegung der Lade um die extreme vordere Stellung befindet;

(a-b) – entspricht der Translationsbewegung der Nadel zum Einfügen in das Kettfach und der zusammengesetzten Translations- und Pendelbewegung zur Annährung des Auffängers;

(b-c) – entspricht der Translationsbewegung der Nadel, die sich seitlich des Auffängers bewegt;

(c-d) – kennzeichnet die Pendelbewegung der Nadel zur Aufnahme des Fadens;

(d-0) – entspricht der Pendelbewegung der Nadel zusammen mit der Translationsbewegung zur Umkehrung des Schussfadendes in das Fach bzw. zum Zurückziehen der Nadel unter die Gewebebene.

Im Ganzen zeigt die Graphik aus Abb. 2 die komplexe Nadelbewegung im Rahmen eines Betriebszyklus, wobei diese Bewegung unter erhöhten Präzisions- und Fiabilitätsbedingungen stattfinden muss. In der Abbildung wird mit punktierter Linie die Position des Schussanschlages bezeichnet. Bei Verfolgung der Anstiege in verschiedenen Zonen der Abbildung kann man die Tatsache feststellen, dass die Nadelbewegung zum Geweberand hin mit relativ grösseren Geschwindigkeiten aus- geführt wird im Vergleich zur Bewegung in umgekehrter Richtung (Zone d-d'), wenn die Geschwindigkeit geringer ist, werden plötzliche Bewegung vermieden, die die Übernahme des Fadens seitens der Nadel sowie die Stabilität des Schussfadenendes in der Hakennadel negativ beeinflussen würde.

Die Realisierung eines entsprechenden Randes verlangt eine Synchronisation der Bewegungen der Nadel- und Fadenauffangmechanismen mit den Bewegungen des Fach- und Ladebildungsmechanismus. Von besonderer Bedeutung für die Qualität des Randes ist die Art und Weise der Synchronisation der Bewegung des Fängers und dem Blatt, das den Schussfaden anschlägt. Zur Herausstellung dieser Synchronisation werden die Ausdrücke des Blatt- und Fängerbereiches, die man erhalten hat nach der Bearbeitung der experimentellen Werte, abgenommen von der Maschine durch Drehung der Hauptwelle schrittweise um 10°entsprechend der Schwingperiode des Ladens von der extremen hinteren Stellung zur extremen Vordestellung, dargestellt. Das Anpassen der experimentellen Daten wurde nach einem Sinusgesetz folgender Form vorgenommen:

$$y = -C \cdot \frac{\varphi_1^2}{4 \cdot \pi^2} \cdot \sin \frac{2 \cdot \pi}{\varphi_1} \cdot \varphi + C_1 \cdot \varphi + C_2 \qquad (1)$$

mit φ_1 – Drehungswinkel der Hauptwelle, nach dem die Oszillation des Blattes bzw. die Bewegung des Fängers zur extremen Vorderstellung ausgeführt wird, (rad);

φ_1=1,2211 rad für das Blatt;

φ_1=0,8722 rad für den Fänger;

φ – laufender Drehungswinkel der Hauptwelle, (rad);

C, C_1, C_2 – Konstanten, die aus den Ausgangsbedingungen bestimmt werden.

Die Ausdrücke des Blatt- (y_s) und Fängerbereiches (y_c) lauten:

$$y_s = 11,46 \sin 5,14\varphi - 58,93\varphi + 72 \qquad (2)$$

$$y_c = 7,48 \sin 7,20\varphi - 53,89\varphi + 47 \qquad (3)$$

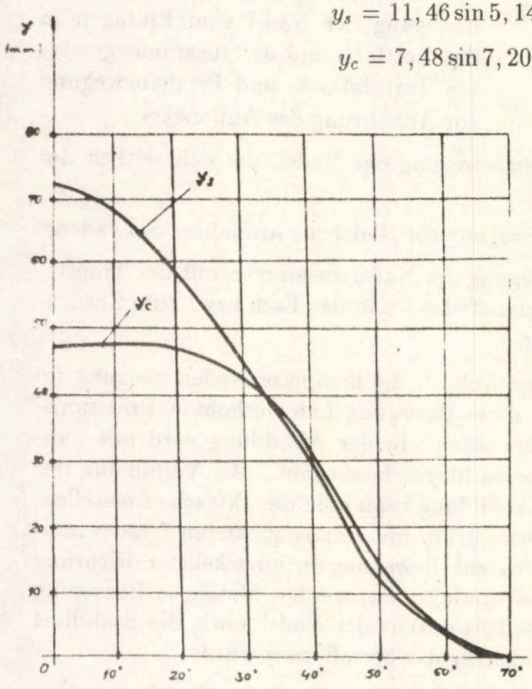

Abb. 3.– Die Bewegung des Blattes (y_s) und des Fängers (y_c).

Da beim Vergleich der experimentell erhaltenen Daten mit denen durch die Berechnung (2) und (3) ermittelten Daten Differenzen bis zu 5% aufgetreten sind, nimmt man an, dass das Anpassen mit dem Sinusgesetz den Erfordernissen entspricht.

Die graphische Darstellung in Abb. 3 zeigt die synchrone Bewegung des Blattes und des Fängers für eine Periode von ca.35°. Im Rahmen dieser Bewegung übernimmt der Fänger das Schussfadende vom Projektil und bewegt sich parallel mit dem Blatt extremen Vorderstellung. Die Realisierung von sauberen Rändern (ohne Fransen) wird entscheidend von der Art und Weise der Synchronisation der Bewegungen des Fängers und des Blattes beeinflusst. Zur Vermeidung des Herausreissens des Fadenendes aus der Fängerklemme ist die Gewährleistung einer Bewegungsversetzung von ±2 mm notwendig diese erhält man mit Hilfe des Reglers für den Randbildunsmechanismus.

3. Technologische und strukturelle Bedingungen. Die eigenheiten hinsichtlich der Einführung des Schusses und der Randbildung auf der STB-Webmaschine führen zu folgenden spezifischen technologischen und strukturellen Bedingungen:

– Die technologische Schussdichte in der Randzone ist doppelt gegenüber der Grunddichte infolge der Einführung des Fadenendes in das folgende Fach mit der Nadel und dessen simultane Verdichtung mit dem letzten Schussfaden (Abb. 4);

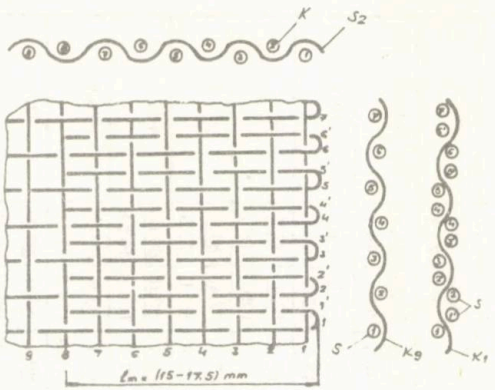

Abb. 4.– Webkante auf der STB-Webmaschine.

– Die Randbreite beträgt 15-17,5 mm und ist von der Arbeitsbreite der Maschine unabhängig. Das führt zu einem zusätzlichen Schussfadenverbrauch bis zu 3,5%.

– Um eine Vergrösserung der Randbreite über die erwähnten Werte hinaus und eine Verschlechterung ihrer Qualität zu vermeiden, macht sich die Zettellung der Kettfäden im Laden einschliesslich in den Randzellen notwendig;

– Ein besseres Festhalten des Schussfadenendes wird, im Falle der Fadenzettelung im Rand, in anderen Litzen als denen des Grundes realisiert.

Die Bearbeitung der Gewebe auf der STB-Webmaschine verlangt eine besondere Aufmerksamkeit was die Projektierung der Ränder anbelangt; die Dicke der Ränder sollte so nah wie möglich der Grunddicke sein. Diese Forderung kann durch richtige Wahl der Bindung, der Dichte und Feinheit der KEttfäden in der Randzone erreicht werden, was zur Vermeidung der Tendenz zum Einrollen des Randes und zu einer gleichmässigen Dicke auf der ganzen Gewebebreite führt.

Um einige Möglichkeiten der Reduzierung von Differenzen zwischen der Grund- und Randdicke herauszustellen, werden in Tabelle 1 die technischen Kennziffern der untersuchten Artikel dargestellt. Es werden die Dicke (G) und der Kompaktheitsgrad (K) des Grundstoffes und des Randes sowohl für die Ausgangsartikel (I) als such für deren Varianten präzisiert. Die Gewebedicke wurde mit einem Mikrometer "Schopper" an den Endproduktproben gemessen. Die Varianten jedes Artikels wurden erhalten durch:

– Veränderung der in einer Ladenzelle gezogenen Fäden in der Randezone unter Beibehaltung der Kettfädenfeiheit;

– Veränderung der Kettfädenfeinheit im Rand und Beibehaltung der in einer Ladenzelle befindlichen Fadenzahl;

– gleichzeitige Änderung sowohl der Feinheit als auch der Kettfädenanzahl in einer Ladenzelle.

Die Analyse der Daten aus Tabelle 1 zeigt, dass in allen Fällen die Randdicke

Tabelle 1

Technische Kennziffern der Artikel

Kennziffern Artikel	Variante	Fadentyp	Feinheit (Nm)		Dichte (Fäden/10cm)		Bindung	Fadenzahl in der Ladenzelle	Dicke G (mm)	Abweichung (%) $\frac{(G_M-G_F)}{G_M}100$	Kompaktheitsgrad K			Abweichung (%) $\frac{(K_{TM}-K_{TF})}{K_{TM}}100$
			U	B	U	B					K_U	K_B	K_T	
A	I	50% PES +	40/1	40/1	240	200	LWB	2	0.350	+30.0	87.5	77.45	82.5	+15.7
		50% ZW	40/1	40/1	240	400	Rips U	2	0.500		96.7	99.1	97.9	
	V_1	"	40/1	40/1	240	200	"	2	0.352	+21.7	87.5	77.45	82.5	-14.9
		"	40/1	40/1	120	400	"	1	0.450		50.7	92.9	71.8	
	V_2	"	40/1	40/1	240	200	"	2	0.350	+25.5	87.5	77.45	82.5	+12.6
		"	50/1	40/1	240	400	"	2	0.470		91.5	97.3	94.4	
	V_3	"	40/1	40/1	240	200	"	2	0.348	+17.1	87.5	77.45	82.5	-18.7
		"	50/1	40/1	120	400	"	1	0.420		48.0	91.5	69.7	
	V_4	"	40/1	40/1	240	200	"	2	0.351	+39.5	87.5	77.45	82.5	-17.9
		"	34/1	40/1	240	400	"	2	0.580		100.7	100.5	100.6	
	V_5	"	40/1	40/1	240	200	"	2	0.355	+26.0	87.5	77.45	82.5	-12.2
		"	34/1	40/1	120	400	"	1	0.480		52.9	94.1	73.5	
B	I	100% BW	34/1	34/1	244	220	LWB	2	0.396	+28.7	89.1	83.0	86.05	+15.8
			34/1	34/1	244	440	Rips U	2	0.556		97.7	106.8	102.3	
	V_1	"	34/1	34/1	244	220	"	2	0.402	+45.8	89.1	83.0	86.05	-28.8
		"	34/2	34/1	244	440	"	2	0.742		117.9	114.2	116.0	
	V_2	"	34/1	34/1	244	220	"	2	0.399	+33.2	89.1	83.0	86.05	-2.5
		"	34/2	34/1	122	440	"	1	0.598		61.6	106.2	83.9	
	V_3	"	34/1	34/1	244	220	"	2	0.400	+23.5	89.1	83.0	86.05	+6.5
		"	70/1	34/1	244	440	"	2	0.523		82.87	101.3	92.1	
	V_4	"	34/1	34/1	244	220	"	2	0.401	+15.7	89.1	83.0	86.05	-23.8
		"	70/1	34/1	122	440	"	1	0.476		43.3	95.7	69.5	

Bemerkung: In der Tabelle sind im Zähler des Bruches die dem Gewebegrund (F) entsprechenden werte und im Nenner die des Randes (M) vermerkt. PES – Polyester; ZW – Zellwolle; BW – Baumwolle; LWB – Leinwandbindung; U – Kette; B – Schuss; T – Gewebe.

(G_M) gegenüber der des Grundes (G_F) um 17,1-39,54% bei Artikel A bzw. 15,7-48,5% bei Artikel B grösser ist. Gleichzeitig erhielt man durch Veränderung der Arbeitsparameter (Feinheit und Kettfadendichte in der Randzone) grössere oder kleinere Werte der Dicke G_M gegenüber der Ausgangsprobe I. Für die industrielle Praxis sind die Varianten mit den kleinsten Abweichungen der Randdicke gegenüber der Grunddicke von Interesse. Dies ist der Fall bei den Artikeln, bei denen beide betrachteten Parameter verändert wurden (Variante V_3-Artikel A und Variante V_4-Artikel B).

Der Kompaktheitsgrad [1] ist ein komplexer Indikator, der in einer unitären Beziehung die definierenden Parameter für eine beliebige gewebte Struktur umfasst. Die Werte des Kompaktheitsgrades drücken das Beanspruchungsniveau der Fäden im Webprozess aus. Hinsichtlich der ausgeführten Varianten stellt man in allen Fällen vergrösserte Werte des Kompaktheitsgrades in Schussrichtung in der Randzone fest als Folge der Verdoppelung der Dichte durch die Zurückführung des Fadenendes im Fach. Die Verkleinerung des Kompaktheitsgrades des Gewebes in der Randzone wird bei allen Varianten boobachtet, bei denen je ein Faden in der Ladenzelle verwendet wurde, was zu einem wesentlichen Abfall des Kompaktheitsgrades in Kettrichtung und damit des gesamten Kompaktheitsniveaus führt.

Man stellt fest, dass im Falle der Variante V_4 des Artikels B, obwohl man eine Verringerung der Randdicke von 28.7% auf 15.7% und des Kompaktheitsgrades des Randes von 102.3% auf 69.5% erhält, ihr Verhalten während des Webens nicht entsprechend war; man erhielt eine Struktur mit ungleichmässigem Aussehen infolge das grossen Ungleichgewichtes der verwendeten Fadanfeinheit. Es sei die Tatsache hervorgehoben, dass man die besten Ränder im Hinblick auf die Qualität und das Aussehen bei den Fäden mit einer Feinheit nahe der Grundkettfäden erhielt.

4. Schlussfolgerungen. 1. Die Webkanten werden auf der STB-Webmaschine mit Hilfe einss komplexen Mechanismus erhalten, dessen Teile genau synchronisierte Bewegungen ausführen.

2. Das Erhalten von Rändern mit einer der dem Grunde angenäherten Dicke ist möglich durch Verwendung von Fadenbindungen, feinheiten und zetteln, die zu einem gegenseitigen Ausgleich der Kompaktheitsgrade führen.

3. Die Realisierung von sauberen und gut verfestigten Rändern verlangt zusätzliche Massnahmen bezüglich ihrer Parameter schon in der Entwurfsphase.

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ASPECTE PRIVIND OBŢINEREA MARGINII LA MAŞINA DE ŢESUT STB

(Rezumat)

În lucrare sînt prezentate caracteristicile marginilor unei ţesături obţinută pe maşina de ţesut tip STB, fiind precizate aspectele cinematice, tehnologice şi structurale specifice, precum şi căile de reducere a grosimii marginii.

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Secţia VIII
TEXTILE. PIELĂRIE

COMPUTER DESIGNING OF SEMI-DOUBLE FILLING-WOVEN FABRICS AS A FUNCTION OF WEIGHT (g/m^2) II. THE ALGORITHM OF CALCULATION FOR DIFFERENT THREAD COUNT FILLING

BY
DANIEL CHINCIU and GABRIEL CORNELIU CHINCIU

1. Introduction. Part I of the present study discussed the algorithm proposed by the authors for designing semi-double filling fabrics with equal thread count values of the filling yarns.

There also exist several situations in which either for the obtainment of fabrics with various efects on both their sides, or for improving their thermoisolating properties, the inferior filling is made of yarns with various linear density values and/or different origin.

Also, for compensating the degree of compactness on the fabric's sides, different thread count values are considered for the filling systems [1], [2].

2. Designing of Semi-double Filling-woven Fabrics with an Alternance Ratio of the Yarn Systems 2 BS : 1 BI. Semi-double filling-woven fabrics with unequal values of linear density and thread count are characterized by $D_{bs} \neq D_{bi}$ and $N_{bs} \neq N_{bi}$ ratios.

The most frequently met non-equilibrum situation is characterized by where from $(D_{bs}/D_{bi}) = 2$ where from $D_{bs} = 2 \cdot D_{bi}$ and $(T_{bi}/T_{bs}) = t_b$ where from $T_{bi} = t_b \cdot T_{bs}$.

If considering, too $(D_u/D_{bs}) = d_{1b}$ there results that $D_u = d_{1b} \cdot D_{bs}$ or $D_u = 2 \cdot d_{1b} \cdot D_{bi}$.

The fabric's weight [2] is given by relation:

$$M = \frac{D_{bi} \cdot [T_{bs} \cdot (t_b + 2) + 2 \cdot d_{1b} \cdot T_u]}{100 - A_{mb}} \cdot \frac{100 \pm p}{100} \qquad (1)$$

where: D_{bi} – thread count of the inferior filling yarns, expressed as picks per 10 cm; T_{bs}, T_u – linear density the superior filling and, respectively warp yarns, in tex;

A_{mb} – total average contraction of the yarns systems, expressed as %; p – weight losses or weight additions in the processes of finishing, expressed as %.

Total average contraction on warp and filling systems is calculated with the relation:

$$A_{mb} = \frac{A \cdot A_{bm} + B \cdot A_{bm} + C \cdot A_u}{A + B + C} \tag{2}$$

where:

$$A = 2 \cdot D_{bi} \cdot T_{bs} \cdot (100 - A_u) \tag{3}$$

$$B = D_{bi} \cdot T_{bi} \cdot (100 - A_u) \tag{4}$$

$$C = D_{ui} \cdot T_u \cdot (100 - A_{bm}) \tag{5}$$

If noting $d_b = (D_{bs}/D_{bi})$; $t_b = (T_{bi}/T_{bs})$; $d_{b2} = (D_u/D_{bi})$, the coefficients present in relation (2) become:

$$A = d_b \cdot T_{bs} \cdot (100 - A_u) \tag{6}$$

$$B = t_b \cdot T_{bs} \cdot (100 - A_u) \tag{7}$$

$$C = d_{b2} \cdot T_{ui} \cdot (100 - A_{bm}) \tag{8}$$

Contraction of the fiber systems in processes of weaving and finishing is expressed by the following relations:

$$A_u = 100 - \frac{(100 - C_{tbi}) \cdot (100 - C_{fu})}{100} \tag{9}$$

$$A_{bs} = 100 - \frac{(100 - C_{tbs}) \cdot (100 - C_{fb})}{100} \tag{10}$$

$$A_{bi} = 100 - \frac{(100 - C_{tbi}) \cdot (100 - C_{fb})}{100} \tag{11}$$

The average contraction on the filling systems is:

$$A_{bm} = \frac{D \cdot A_{bs} + E \cdot A_{bi}}{D + E} \tag{12}$$

where:

$$D = 2 \cdot D_{bi} \cdot T_{bs} \cdot (100 - A_{bi}) \tag{13}$$

$$E = D_{bi} \cdot T_{bi} \cdot (100 - A_{bs}) \tag{14}$$

2.1. Designing through thread count modification. Parameters known: m, D_{bs}, T_{bs}, T_b. Parameters to be calculated: D_{bi}, D_u.

Thread count of inferior filling is calculated with relation (1):

$$D_{bi} = \frac{m(100 - A_{mb})}{T_{bs} \cdot (t_b + 2) + 2 \cdot d_{1b} \cdot T_u} \cdot \frac{100}{100 \pm p} \tag{15}$$

while thread count of warp with relation:

$$D_u = 2 \cdot d_{1b} \cdot D_{bi} \tag{16}$$

The thread count values thus obtained are rounded off, so that the last figure should be either 0 or 5; starting from these figures, weight is recalculated by relation (1), the admitted deviation from the imposed value being thus established.

2.2. Designing through linear density modification. Parameters known: m, D_{bs}, D_u, T_{bs}. Parameters to be calculated: T_{bi}, T_u.

Starting from the $(T_{bs}/T_u) = t_{1b}$ ratio, from which the equalities $T_u = (T_{bs}/t_{1b})$ are derived, and substituting them in relation (1, Part II), there results:

$$M = \frac{T_{bi} \cdot [D_{bs} \cdot n_{1b} \cdot (n_b + 2) + 2 \cdot D_u]}{2 \cdot n_b \cdot n_{1b} \cdot (100 - A_{mb})} \cdot \frac{100 \pm p}{100} \tag{17}$$

Linear density of the warp yarns is obtained from relation:

$$T_{bi} = \frac{2 \cdot m \cdot n_b \cdot n_{1b} \cdot (100 - A_{mb})}{D_{bs} \cdot n_{1b} \cdot (n_b + 2) + 2 \cdot D_u} \cdot \frac{100}{100 \pm p} \tag{18}$$

while linear density of the warp yarns is obtained from relation:

$$T_u = \frac{T_{bi}}{t_{1b} \cdot t_b} \tag{19}$$

The calculated values thus obtained are compared with the standard ones, the closest one being considered. Weight is recalculated with relation (17), and deviation from the imposed values is established.

3. Conclusion. The algorithms proposed by the authors of the present paper have relatively simple solutions for designing or redesigning of semi-double filling – woven fabrics, as a function of weight – expressed as g/m^2.

New notations have been introduced, such as "average contraction on yarn systems, in processes of weaving and finishing" or "total average contraction", supporting the designing method suggested.

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PROIECTAREA ASISTATĂ DE CALCULATOR A STRUCTURILOR ŢESUTE SEMIDUBLE DE URZEALĂ FUNCŢIE DE MASA ÎN g/m^2 II. ALGORITM DE CALCUL PENTRU DESIMI DIFERITE ÎN URZEALĂ

(Rezumat)

Algoritmul de calcul prezentat în lucrare este conceput pentru proiectarea asistată de calculator a ţesăturilor semiduble de bătătură cu desimi diferite şi corespunde condiţiilor de portabilitate pe calculatoarele compatibile PC în orice limbaj de programare.

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TEXTILE. PIELĂRIE

YARN TENSION IN TEXTIMA MIDDLE STOP MOTION (PART II)

BY
RODICA BUDULAN

1. Introduction. In the first part of this paper [1] we dealt with the construction and the functional characteristics of the middle stop motion device used at circular knitting machines Textima type. The study carried out the particular conditions of setting this device for Multisingle machines and, for this case, the limits of the yarn tension were established.

As an extension of this study we have taken into consideration the different possibilities of setting the device at different types of Textima machines and the different paths of the yarn as a function of the feeding type, to stress upon the complete possibilities of this device.

2. The Analysis of the Device Setting Possibilities. The positions that can be reached by the device are: a vertical one (at Multikarat and Multicomet machines) and an inclined one at an angle $\omega = 45°$ (at Multisingle machines).

The path of the yarn in the device depends upon the feeding type and its possibility of passing or not through the tension adjusting device.

These cases are presented in Figure 1, corresponding to the following situations:

a – the path of the yarn for negative feeding when the yarn passes through the tension adjusting device,

b – the path of the yarn for negative or positive feeding, without passing of the yarn through the tension adjusting device.

The device can be set at an angle ω from the vertical line that can be adjusted $(0 - \omega_{max})$. The maximum value of the angle ω is in relation with the yarn carrier position (angle δ).

3. Calculating Yarn Tension. In accordance with Figure 1 from this paper and from the previous one [1], we consider the following as known elements: a, b, c, d, d', e_1, e_2, e_3, h, j, $l = OC$, l', $l_1 = OP$, l_g, β, ψ, ω.

Relying on these elements we can determine the unknown elements:

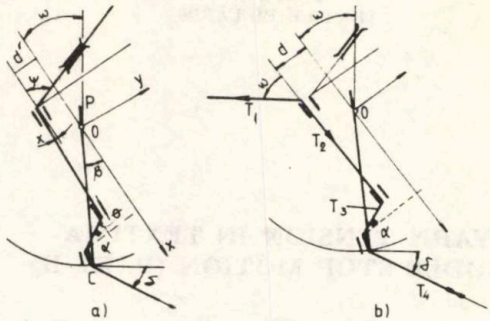

Fig. 1.– Paths of the yarn in Textima middle stop motion

– the angles: $\theta, \alpha, \delta, \gamma, \lambda$;
– the spring lenght: l_a;
– the elastic spring force: N;
– the yarn tensions: $T_1 - T_4$.

The general formulas for all these elements are presented in Table 1.

Table 1

	β_1	β_2 β_3 β_4
θ	0	$\arctan \frac{l' \cdot \sin(\beta+3)-d}{l' \cdot \cos(\beta+3)-c} \pi + \arctan \frac{l' \cdot \sin(\beta+3)-d}{l' \cdot \cos(\beta+3)-c}$
α	90	$90-\theta$
δ	δ_1	$\arctan \frac{b+l \cdot \cos(\omega-\beta_1)-l \cdot \cos(\omega-\beta)}{a+l \cdot \sin(\omega-\beta_1)+l \cdot \sin(\beta-\omega)}$
γ		$\beta - \beta_1$
λ		$\arctan \frac{e_3-l_1 \cdot \sin\gamma-e_2 \cos\epsilon}{l_1 \cdot \cos\gamma+j-e_2 \sin\epsilon}$
l_a		$\frac{e_3-l_1 \sin\gamma-e_2 \cos\epsilon}{\sin\lambda}$
N		$k \cdot (l_a - l_0)$
T_1		$\frac{N \cdot l_1 \cdot \sin(\gamma+\lambda)+G \cdot l_g \cdot \sin(\omega-\beta)}{\exp l \cdot \cos(\alpha+\beta+3)+\exp l \cdot l_g \cdot \cos(\delta+\omega-\beta)}$
T_3	$T_1 e^{\mu(\psi-\beta+\beta_1)}$	$T_1 e^{\mu(\psi-2x+\theta)} = T_1 \cdot \exp$
T_4	$T_1 e^{\mu(\psi-\omega+\pi/2-\delta)}$	$T_1 e^{\mu(\psi-2x+2\theta-\omega+\pi/2-\delta)} = T_1 \cdot \exp 1$

The angle β interval can be divided into segments using the characteristic values of β:

β_1=12°– initial position, where the mobile eye is on line with the fixed ones;

β_2=15°– position as far as the yarn is not bent in the mobile eye (α=90° and θ=0°, $T_2 = T_3$);

β_3=34.25°– position in which α=0° and θ=90°;

β_4=62° or 82°– final position of the mobile eye in correlation with the adjusting screw position ($h_{\min} - h_{\max}$).

In comparison with the previous paper [1], we specify that now the mobile eye dimensions are not neglected and all the yarn tensions $T_1 - T_4$ are calculated as a

function of the initial yarn tension T_1, when it enters the stop motion device.

To calculate the values of all these unknown elements, a computer program has been achieved, taking into account the different settings of the device by varying the ω angle.

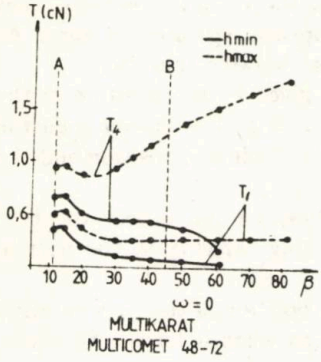

Fig. 2.– Yarn tensions for $\omega = 0$

4. Conclusions and Interpretation of the Results. Using the results obtained from the computer we can establish the limits and the variation for the unknown elements as a function of β.

In Figure 2, the yarn tension ($T_1 - T_4$) variation as a function of angle β is presented, in the case $\omega = 0$, when the device is set vertically. In this case it can be observed that the device has a small compensating capacity for the normal functioning of the machine ($\beta = 12° - 45°$).

In Figure 3, a similar situation is presented, for the case $\omega = 45°$. This case clearly shows a higher capacity of yarn tension compensation, that means the efficiency and the sensitiveness of the device are larger.

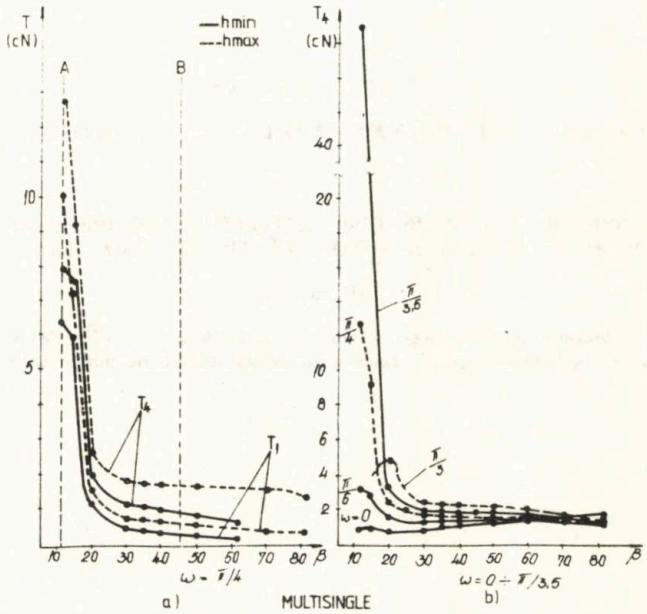

Fig. 3.– Yarn tensions for $\omega > 0$

Studying the influence of the device setting angle (ω) upon the yarn tension when it leaves the device (T_4), in Figure 3.b, we notice that the increase of this angle urtil it reaches the $\pi/4$ value also determines an increase of the device compensating capacity from 1 cN to about 10 cN which is sufficient for normal working conditions at this type of machines.

The further increase of the angle ω from the $\pi/4$ to the $\pi/3.5$ values determines a much more important extension of the device compensating capacity above 45 cN, a value that is not justified as necessary in normal working conditions.

The further increase of the angle ω has a limit given by the position of the device referring to the yarn carrier. For exemple, if $\omega = \pi/3$, whatever high the yarn tension might be, it cannot keep the mobile eye in the initial position and the device does not work normally.

In conclusion, taking into account our necessities, we can choose the best setting angle that will assure the suitable compensating capacity to the normal yarn feeding tension interval.

Analysis of the computer data indicates that the position of the yarn entering the device has a minor influence upon the yarn tension when it leaves the device (T_4).

The graphs shown in the paper are useful means for the rapid determination of the yarn tensions, for different concrete cases, as a function of the ω and β angles.

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TENSIUNILE ÎN FIR ÎN DISPOZITIVELE DE COMPENSARE A TENSIUNII ŞI DE OPRIRE AUTOMATĂ TIP TEXTIMA (Partea a II-a)

(Rezumat)

Studiul prezentat în partea întîi este extins prin generalizarea relaţiilor de calcul pentru orice poziţie de montare a dispozitivului şi prin analiza capacităţii sale de compensare.

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TEXTILE. PIELĂRIE

DEVELOPMENTS IN MAKING AND USING COMPOUND NEEDLES ON AUTOMATIC FLAT KNITTING MACHINES (PART II)

BY

MIRCEA MATEESCU, STELIAN FILIPESCU and LILIANA TOADERE

1. General Elements. In the literature there are mentioned patents of knitran systems used by the automatic flat knitting machines with compound needles. [1, 2].

All these solutions used pressing cams for the seletion and the projection of the hook element butt and closing element butt from the needle trick in one of these positions "o", "s", "i" ("o" – means without butt, "s" – short butt, "i" – long butt). This means that, besides the up and down movement in the needle tricks of the hook and closing element, there is an oscillating movement of the hook element, too. Also, the way of moving the hook element and closing element is very intricate.

The knitran system presented here eliminates these disadvantages. Instead of pressing cams mobile cams and wings are used (cams which can be sunk into the cam plate by the needle butts, only for one direction of the carriage) and all the elements have only up and down movements.

2. Knitran System for Autentic Flat Knitting Machines Having Compound Needles with Laterally Extended Rib Loop Transfer Spring on the Hook Element

2.1. The Construction of the Knitran System. The knitran system (Figs.1.a and 1.b) consists of cams situated on two levels which correspond to the butts (*3*) and (*4*) of the jacks (*5*) and (*6*) used for the movement of the hook element (*1*) and closing element (*2*). These levels are:

A. Cams for the hook element movement:

7, 8, 9 – knitting cams

10, 11 – up throw cams

12 – fixed cam for transfer

13 – fixed guide cam

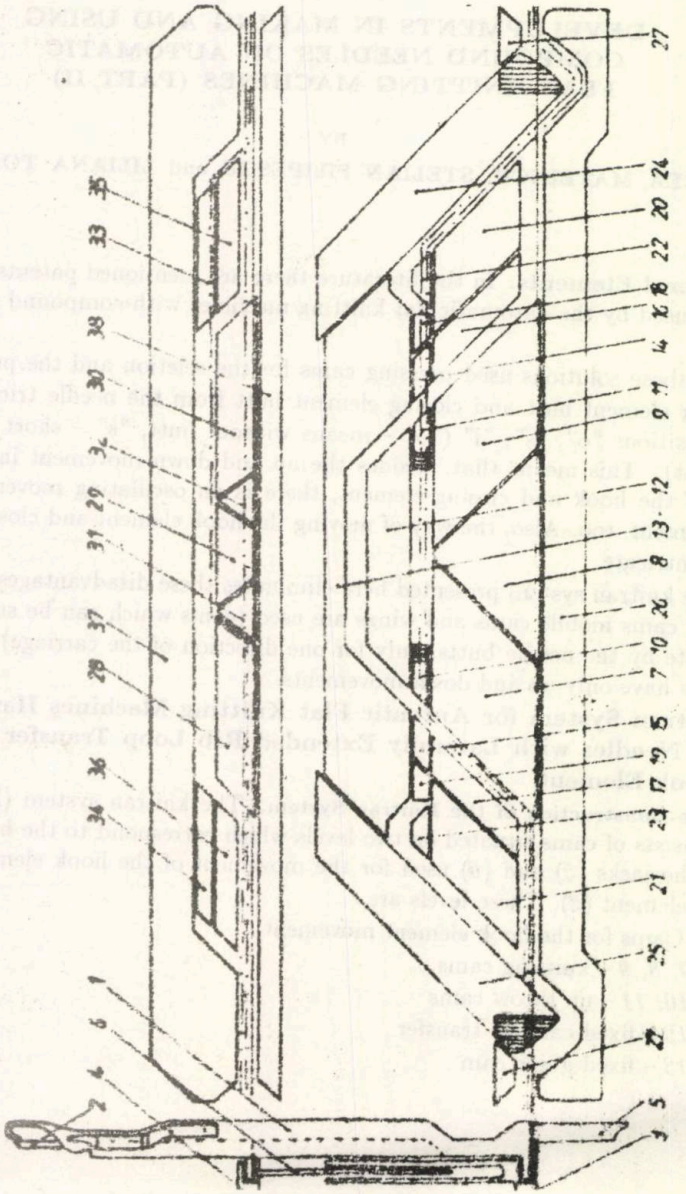
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Fig. 1.a

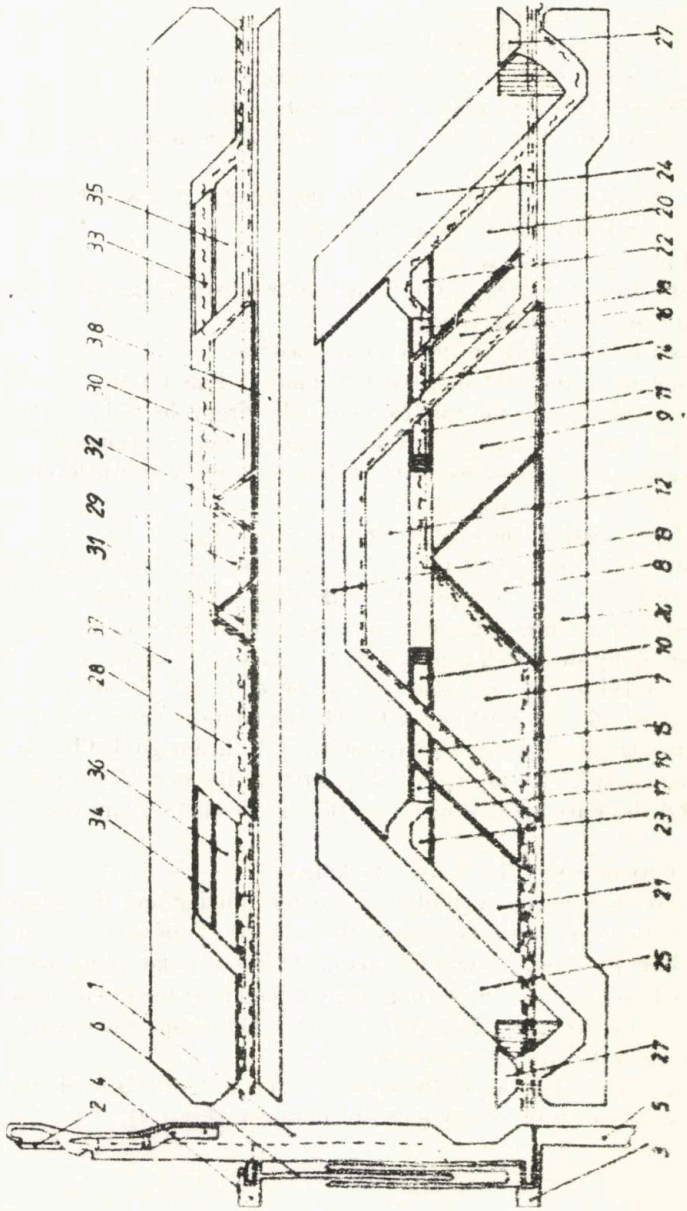
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Fig 1.6

14, 15, 16, 17 – going off cams to the transferring position
18, 19 – going off cams to the receiving position
20, 21 – fixed going off cams to the receiving position
22, 23 – supplementary raising cams to clearing position after receiving
24, 25 – stitch cams
26, 27 – fixed guide cams to ground position

B. Cams for the closing element movement:
28, 29, 30 – guide cams
31, 32 – knitting cams (and transfer cams)
33, 34 – going off cams to the transferring position
35, 36, 37, 38 – fixed going off and guide cams

Finally, the fixed cams are: *8, 12, 13, 20, 21, 26, 27* on A level and *35, 36, 37, 38* on B level.

Cams *7, 9, 10, 11, 14, 15, 16, 17, 18, 19, 22, 23, 24, 25, 28, 29, 30, 31, 32, 33, 34* are mobile and they can be positioned for:

– knitting true three-way technique
– transfer from the back to the front bed or viceversa (transfer and receiving on the both beds) without knitting
– transfer and knitting on the receiving needles.

2.2. The Analysis of the Technological Possibilities. Figs.1.a and 1.b show the technological possibilities at the cam carriage travel from the right to the left.

Because of the selection the butts (*3*) and (*4*) can be positioned "o", "s", or "i" and because of the positions of the mobile cams on A and B levels three ways for knitting can be obtained (Fig.1.a):

a) "i" butt position; the way for knitting (– · – · – · – · – · –)

The butt (*3*) of the hook element (*1*) is put in advance into a raising movement by the knitting cam (*7*) („+ " position). Because of the position "–" of the wing (*10*), the butt (*3*) remains to the inferior verge of the fixed cam (*12*), sink the wing (*11*), is gone off by the stitch cam (*24*) („+ " position), (cams *14, 18, 22* position "–") and is guided by the fixed guide cams (*26*) and (*27*). Because of the position "–" of the cam (*28*), the butt (*4*) of the closing element (*2*) is put into a raising movement by the knitting cam (*31*) (position "|"), then is guided by the fixed cam (*37*) and the cams (*29*), (*30*), (*32*) ("|" position). Because of the position "–" of the cam (*33*) the butt (*4*) is gone off by the fixed cam (*37*) and then by the cam (*38*).

b) "s" butt position; the way for tucking (– · · – · · – · · –)

The hook element has a similar way as for knitting and the closing element remains to the ground position because the position "|" of the cam (*31*).

c) "o" butt position; the way for missing (without re-knocking over) (———).

The hook element and the closing element remain at the ground position because of the position "o" of the butts (*3*) and (*4*). That means missing and stretching the old stitches without another knocking-over.

Because of the positions of the mobile cams on A and B levels the following ways for transferring and receiving can be obtained (Fig.1.b).

d) "i" butt position; the way for transfer (- - - - - - -)

The butt (*3*) (position "i") of the hook element (*1*) is put in advance into a raising movement by the knitting cam (*7*) ("|" position). Then the butt (*3*) is raised by the wing (*10*) ("|" position) and by the fixed cam (*12*) to a position superior to the clearing position ($I_{+\Delta}$) and then is guided by the fixed cam (*13*). The cams (*14*) and (*16*) ("|" position) go off the butt to the ground position where is guided by the fixed cams (*20*), (*26*), (*27*) (the stitch wing (*24*) is in position "–"). Because of the position "–" of the cam (*28*), the butt (*4*) of the closing element raises under the action of the knitting cam (*31*) ("|" position) and is guided then by the fixed cam (*37*) and the mobile cams (*29*), (*30*) ("|" position), The cams (*33*) and (*35*) (*33*-position "+", *35*-fixed cam) go off the butt (*4*) to the ground position, where is guided by the cams (*37*), (*38*).

e) "s" butt position; the way for receiving (– · · · – · · · –)

The butt (*3*) (position "s") of the hook element (*1*) is put into the movement by the fixed cam (*8*) (cam (*7*) in position "|") and is guided by the fixed cam (*12*). This enables the sinking of the wing (*11*). The cam (*18*) ("+" position) and the fixed cam (*20*) go off the butt (cam (*14*) and (*16*) position "|") to the ground position where the butt is guided by the fixed cams (*26*) and (*27*) (the stitch wing (*24*) position "–"). The butt (*4*) is guided at the ground position by the fixed cams (*35*), (*37*) and (*38*) (cams (*28*), (*31*), (*29*), (*32*) and (*30*) position "|").

f) "o" butt position; the way for missing without re-knocking-over (————).

The hook element and the closing element remains at the ground position because the butt (*3*) and (*4*) are "o" positioned. That means missing and stretching the old stitches without another knocking-over.

g) "s" butt position; the way for receiving and knitting on the receiving needles (~ ~ ~ ~).

For receiving and knitting on the receiving needles, the butt (*3*) is put into movement by the fixed cam (*8*) (cam (*7*) position "|"), is then guided by the fixed cam (*12*) and sinks the wing (*11*). The cam (*22*) ("+" position) puts the butt (*3*) of the hook element (*1*) (cams (*14*) and (*18*) position "|") into a supplementary raising movement for the supporting and stretching the transfer stitch on the shoulder of the hook element. Then the butt (*3*) (and the hook element (*1*)) is gone off by the stitch wing (*24*) ("+" position) for knocking-over. Because of the position "|" of the cams (*28*), (*31*), (*29*), the knitting cam (*32*) ("+" position) put the butt (*4*) of the closing element (*2*)) into movement to clearing position. Then the butt (*4*) is guided by the fixed cam (*37*) and (because of the position of the cam (*33*) "|") is gone off to the ground position by the fixed going off cam (*37*).

3. Conclusions. The knitran system for automatic flat knitting machines having compound needles with laterally extended rib loop transfer spring on the hook element enables:

– the independent movements – in accordance with the selection – of the hook and closing elements for three-way technique: knitting, tucking, missing without re-knocking-over of the old stitches;

– the independent movements-in accordance with the selection-of the hook and closing elements for three way at transfer: transferring, receiving and missing;

– the fourth possibility for the receiving needles: they can knit after receiving if a yarn is fed into the hook;

– stitches transfer from the back to the front bed or vice-versa irrespective of the direction of cam carriage travel;

– the yarn feeding only in one zone, both for knitting and for receiving + knitting.

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DEZVOLTĂRI ÎN CONSTRUCŢIA ŞI UTILIZAREA ACELOR CU ZĂVOR LA MAŞINILE RECTILINII DE TRICOTAT AUTOMATE (Partea a II-a)

(Rezumat)

Lacătul integrat pentru maşini rectilinii de tricotat automate echipate cu ace cu zăvor şi lamela de transfer extinsă lateral situată pe tija cu cîrlig permite acţionarea independentă a tijelor cu cîrlig, respectiv tijelor zăvor.

De asemenea, se pot obţine, conform selectării şi poziţionării camelor mobile, trei traiectorii pentru tricotare, trei traiectorii pentru transfer şi o traiectorie pentru transfer-primire şi tricotare (cu alimentare cu fir).

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Tomul XXXVIII (XLII), Fasc. 1–4, 1992
Secţia VIII
TEXTILE. PIELĂRIE

RESEARCHES ON USING COMPUTER TECHNIQUES IN PROGRAMMING AND CALCULATING THE TECHNOLOGICAL PARAMETRES WITH THE SINGLE JERSEY MACHINES SUPPLIED WITH PATTERNING WHEELS

BY

COSTEA BUDULAN and MARIANA URSACHE

1. Introduction. Computer programming of machines patterning devices can be nowadays a useful method which allows a very important increase in the efficiency of the technological programming activity.

The paper presents the structure and the way of using the programmes achieved on TIM-S, ZX-Spectrum and HC-85 for the technological programming and calculation of the technological parametres of the single knit machines which are supplied with patterning wheels.

This kind of knitting machines is built for producing plain terry patterns but their fabric potential also includes plain jersey and plated fabrics.

2. Considerations on Programme and Results. Calculation of the technological parametres of the knitting operation and technological programming of the knitting machines demands a great deal of time and high specialised personnel because the final quality, the dimmensional stability and the parametres uniformity structure of the knitted fabrics as well as the rapidity of the patterning device programming depend on the correctness and quality of performing this stage.

Using such computer programmes in patterning device programming leads to an increased flexibility on changing one pattern with another.

The elaboration of the programme by using computer technique requires observing the following methodology:

I. Good Knowledge of Knittting Machine Technical Characteristics:

- Gauge: K [E]
- Number of feeds: S
- Number of needles: Na
- diameter: D ["]

II. The Correct Knowledge of Loop Forming Mechanism:

– Loop forming elements (needles, sinkers, pattern jacks a.o.);

– Construction of the cams and their possible positions.

III. The Construction and Selecting Principle of the Patterning Device:

– each feeder is supplied with a patterning wheel which ensures, according to the construction of the machine, the individual selection of the needles or pattern sinkers.

IV. The Analysis of the Technical Possibilities of the Machine:

– The analysis of the loop forming mechanism and of the patterning device leads to a better knowledge of the technical possibilities of the machines group for which the programme is elaborated.

V. Establishing the Dimension and the Way of Disposing of Pattern Areas:

Establishing the maximum dimensions of the pattern which can be performed on a certain type of knitting machine depends on the number of needles and number of pattern jacks. Thus, the maximum area of the pattern usually has a quadrangle shape with the following dimensions:

b_{max} – number of columns on the face side of the fabric (pattern width);

H_{max} – number of raws on the face side of the fabric (pattern hight).

The determination of these dimensions is achieved as following:

1. Find the lowest common factor of the number of needles and jacks: this represents the maximum width of the pattern (b_{max});

2. Divide the maximum width of the pattern into the number of jacks in the patterning wheel. The quotient is the number of revolutions in the pattern (h);

3. The result of multiplying the number of revolutions in the pattern (h) with the number of feeds (S) is the maximum hight of the pattern (H_{max});

4. As the number of jacks is not usually a divisor of the number of needles, the maximum area pattern has a spiral disposition (shown in Fig.1).

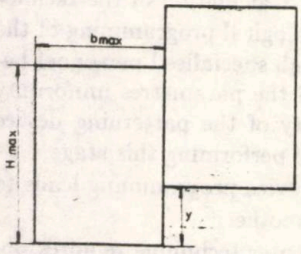

Fig. 1.– The pattern spiral disposal

$$Na/P = n + r/P \qquad (1)$$

This spiral disposition is characterised by the vertical declaration Y which is determined by the following calculation:

$$Y = S \cdot [h \cdot (c+1) - 1]/(r/b) \qquad (2)$$

in which: c – the smallest full number starting with zero for which the result of relation (2) is smaller than H_{max};

r – the remainder of the relation (1).

The adopted pattern area may not have the maximum dimensions, but it should cover the following conditions:

– the width of the adopted pattern (b) must be a divisor of the maximum width (priorly calculated);

– the hight of the adopted pattern (H) must be a divisor of the maximum hight (H_{max}) previously calculated.

VI. The Calculation of the Technological Parametres:

The technological parametres which can be determined by using this programme are: stitch depth (X [mm]), supply rate (Va [m/min]) or consumption rate (Vc [m/min]) and input tension (Ta [cN]).

Stitch depth will be calculated according to the construction of the machine. Thus, for single knit machines, in calculating stitch depth the M i l c e n k o method [1] will be used.

Considering that in making the pattern fabric the supply is negative, the consumption rate is calculated according to the structure parametres and certain technical characteristics of the machine:

$$Vc = n \cdot lo \cdot Na \cdot 10^{-3} \quad \text{(m/min)}$$

in which: n – number of revolutions per minute (m/min);

Na – number of working needles;

lo – stitch length (mm).

In calculating the input tension, the thread concrete tract (from the yarn package up (down) to the needle in stitch forming position) is considered for a certain machine. So, the final tension is resulted from cummulating all tensions which appear as a consequence of unfolding the thread from the yarn package, of passing with friction on the guiding organs, through the tension and control dispositives, turn of the thread into stitch and dynamic tension.

3. Use of the Programme. The general scheme of the programme is shown in Fig. 2, being structured on two optional parts of the main menue.

The former part comprises, at choice, the calculation of the above mentioned technological parametres. The latter part comprises the programming of the patterning device for an adopted pattern.

Procedure:

The programme is conversational, the user being committed to the part of the menue in which one takes interest at a certain moment.

In case that one choses the programming part, the programme contains control subrutines which do not allow the input of wrong data or symbols which differ from those in the programme, the user being obliged to introduce correct data for a normal running.

The result of the programming is a display of a programming table with a following content:

R	S	Z	m	The succesion of "P" and "G"
				P G P G P G P G P G P G P G

in which:

R – the number of the raw in the pattern;

S – the number of feeder which achieves the "R" raw in the pattern;

Z – colour of the yarn;

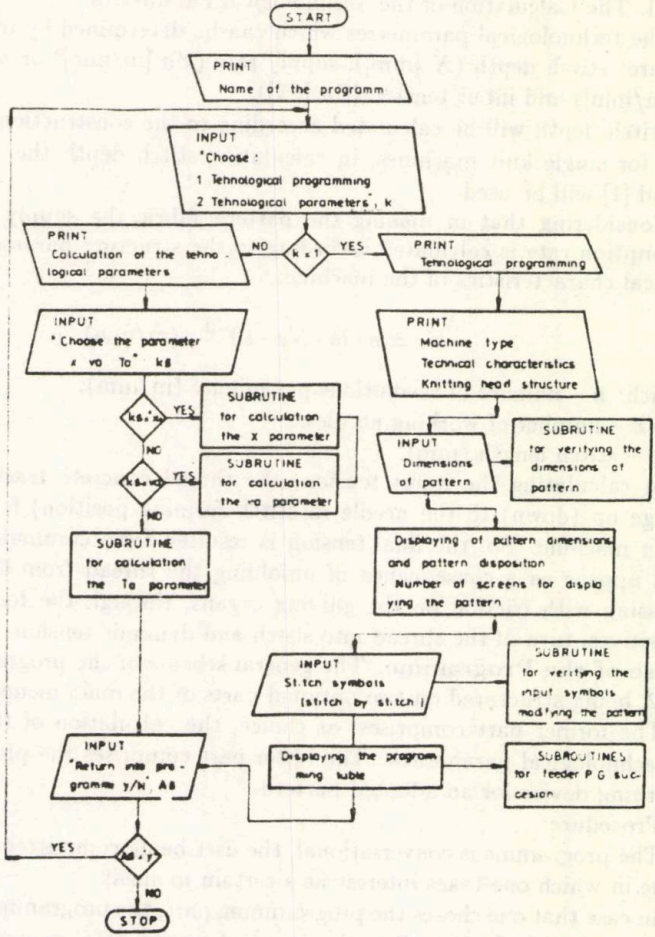

Fig. 2.– The general scheme of the programme

m – the number of the section in the patterning wheel with which "R" is started;

P – the number of consecutive jacks in patterning wheel;

G – the number of consecutive missing jacks in patterning wheel.

4. Conclusions. – The present programme can be used with all circular knitting machines which are supplied with patterning wheels;

– The programme is easy to use, the possibilities of introducing false data being excluded;

– The result of the programme can be listed on the printer for its immediate use in production;

– The use of this programme significantly reduces the time of technological programming and calculation of the technological parametres.

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CERCETĂRI PRIVIND UTILIZAREA TEHNICII DE CALCUL LA PROGRAMAREA TEHNOLOGICĂ ŞI CALCULUL PARAMETRILOR TEHNOLOGICI AI OPERAŢIEI DE TRICOTARE LA MAŞINI CIRCULARE DE TRICOTAT CU DIAMETRU MARE CU O FONTURĂ, PREVĂZUTE CU MECANISM DESENATOR CU DISCURI DESENATOARE

(Rezumat)

Lucrarea prezintă metodologia de proiectare a parametrilor tehnologici ai operaţiei de tricotare şi de programare tehnologică a maşinilor circulare de tricotat prevăzute cu mecanism desenator, utilizînd tehnica de calcul. Programul complex a fost elaborat în limbaj conversaţional BASIC, uşor de exploatat, a cărui utilizare nu necesită personal specializat în utilizarea lui.

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Secţia VIII
TEXTILE. PIELĂRIE

ÉTUDE SUR LES DIMENSIONS ANTHROPOMÉTRIQUES AUX PIEDS DES PETITS ENFANTS ET DES ENFANTS N'AYANT PAS L'ÂGE SCOLAIRE

PAR

DAN FLORIN CROITORU et CORNELIA IONESCU

1. Introduction. L'étude des dimensions antropométriques occupe une place importante dans la sphère des préoccupations des spécialistes qui travaillent dans le domaine des confections de chaussure en Roumanie, les dimensions anthropométrique représentant des données primordiles indispensables dans la détermination de la forme et des dimensions des embauchoirs et de la chaussure.

Le travail s'est proposé de présenter et d'analyser les valeurs moyennes de principales dimensions anthropométriques des pieds de petits enfants et des enfants n'ayant pas l'âge scolaire que les auteurs de ce travail ont obtenues à base de dimensions anthropométriques [1] effectuées sur un échantillon de 1400 sujets (fillettes et garçons) à partir de l'âge d'un mois jusqu'à sept ans.

2. Mode de travail. Les dimensions ont compris une large gamme de paramètres principaux qui sont à la base des la projècts des embauchoirs et de la chaussure: longueur du pied; largeur du pied au niveau des doigts et du talon, périmètre du coup-de-pied et du talon.

La représentativité de la sélection a été verifiée à base de la loi de distribution normale unidimensionnelle Gausse-Laplace, pour tous les paramètres analysés [2].

Par des remaniements statistico-mathématiques [3] on a déterminé: les moynnes arithmétiques pondérées des paramètres anthropométriques ($\overline{x}$), les exceptions standard de selection (S_x) qui nous montre approximativement le degré de dispersion des valeurs autour de la moyenne et le coefficient de variation (C_v) indicateur en pourcentage qui exprime, le degré de dispersion autour de la moyenne.

3. Résultats et commentaires. Les valeurs des paramètres statistiques des dimensions anthropométriques sont mises en évidence dans le tableau 1.

En considérant pour chacun des paramètres analysés le domaine de diffusion de $\pm 3S_x$ correspondant à une probabilité de 99,33 %, on a constaté que dans cet intervalle ont été comprises toutes les valeurs particulières diffusées autour de la

Tableau 1

Nr. crt.	Paramètres anthropométriques	Paramètres établis $\bar{x}$ (mm)	S_x (mm)	C_v (%)
1.	Longueur du pied	173,12	19,38	11,19
2.	Largeur aux doigts	72,44	7,34	10,14
3.	Largeur du talon	47,84	4,80	10,03
4.	Périmètre aux doigts	169,29	16,24	9,58
5.	Périmètre du coup-de-pied	176,71	17,76	10,05
6.	Périmètre au talon	221,07	22,46	11,06

moyenne ce qui a confirmé que l'échantillon mesuré a été constitué par un nombre suffisant de sujets.

En analysant les paramétres anthropométriques par la valeur de la dispersion on constate que: la longueur moyenne du pied à cette catégorie d'âge est de 17,3 cm, la largeur moyenne aux doigts est de 4,76 cm avec une dispersion de 2,7 cm à 6 cm, le périmètre moyen aux doigts de 17,67 cm avec une dispersion de 8 cm à 22,8 cm.

Cette grande dispersion des paramètres autour de la moyenne s'explique par le grand facteur d'accroissement des dimensions du corps de l'enfant pendant le premier cycle de vie.

4. Conclusions. Les dimensions anthropométriques effectuées sur les petits enfants et sur les enfants n'ayant pas l'âge scolaire ont mis en évidence que le paramètre principal, la longueur du pied, a augmenté à partir de dernières mesures et que dans la corrélation avec les modifications longitudinales il s'est produit des transformations de tous les paramètres transversaux. Ces conclusions mènent à la nécessité de la revision périodique des standards des embouchoirs .

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Institut Polytechnique, Jassy,
Chaire de Tricotage
et Confections

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STUDIU PRIVIND MĂRIMILE ANTROPOMETRICE ALE PICIOARELOR LA COPIII MICI ŞI PREŞCOLARI

(Rezumat)

În lucrare se prezintă valorile medii ale unor mărimi antropometrice, rezultate în urma unui studiu antropometric efectuat asupra picioarelor copiilor cuprinşi în categoria de vîrstă de la o lună pînă la şapte ani.

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Secţia VIII
TEXTILE. PIELĂRIE

STUDY ON MANAGEMENT OF FORMING TECHNOLOGY WITH A VIEW TO SPACE FORMS STABILITY

BY
GABRIELA MĂLUREANU

One of major quality features apt to influence the aesthetics and confort in footwear used by customers is the stability of spatial form which will be conferred to the product in the manufacturing process [1].

Untill now there haven't been established quantitative indexes of stability at formation so that the estimation of products quality as to their spatial formation must be done, as a rule, visually.

Some researches in the domain tackle the aspect of geometrical dimensions stability or of some networks traced on the semifinished product.

The main faults of footwear form and dimensions after formation are manifested either through the increase or decrease of transversal dimensions of the top ensemble, or through its wrinkling or twisting.

Among the influence factors on footwear stability at formation there must be mentioned:the capacity of deformation at tensile loads, the duration of tensile stress, the associations of some thermal duties to a mechanical stress, a.s.o.

The higher and longer the material deformation is,the more stable the spatial form conferred to the product is, because the relaxing of interval tensions which appear in the semifinished product structure in the formation process through extension determine the increase of its remanent deformations and that is why it becomes less able to be deformed under future loads which appear in the product use.

As a consequence, the time factor has an important role in the stability at formation of products made of leather or substitutes. The necessity of decreassing footwear manufacturing cycle as well as of shortening the time the semifished product is kept under tension on the last impose the association of thermal duties to mechanical load so as to ensure the stability of the footwear spatial form.

In this study, we have tried to estimate the influence of some parameters involved in the semifinished structure on the spatial form stability.

The product stability at formation was appreciated according to the degree of modification in time of form, and cross section in the area behind the toe cap [2,3].

To this purpose, by using a profilograph we have plotted the contour of the cross section of footwear stretched on the last and once again at a specific time after having taken it out of the last.

The index of stability at formation was calculated with the following relation (Fig. 1):

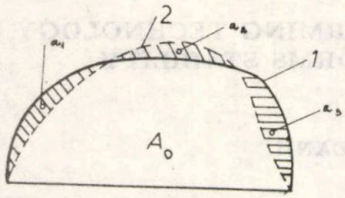

Fig. 1

$$\Phi = \frac{\sum a_i}{A_0} \cdot 100[\%]$$

where: A_0 – area of initial surface of semifinished product consection in tensile stress on the last (mm); $\sum a_i$ – sum of areas formed as a consequance of cross section contour deviation, at a certain moment, from the initial cross section (mm).

The lower the values of this index the higher the stability of the spatial form.

The semifinished product were made up of 1,2 or 3 layers, the exterior one being synthetic leather with polyurethane film on a veil support, having $\sigma_r = 0.98$ daN/mm^2, $\varepsilon_r = 67\%$ and average $\cong$ 1 mm; they were subject to spatial formation by stressing in indentical conditions; subsequently they were subjected to vainious tension relaxing regimes.

Table 1

	The experimental conditions
I	The maintenance in tension on the last for 10 minutes
II	The maintenance in tension on the last for 24 hours
III	The maintenance in tension on the last for 7 days
IV	The maintenance under a thermal agent with θ =160°C for 3 minutes
IV	The maintenance under a thermal agent with θ =160°C for 10 minutes

In Table 2 there are given values of the Φ index characterizing stability after formation in the cross section situated at 5 mm behind the toe cap.

Time values after taking the last out of the semifinished product for the measurement of Φ parameter are.

In Fig. 2 there are shown in semilogarithmical coordinates the Φ index variation in time for the semifinished product in one layer (unlined for the five working regimes).

It can be seen that the working regime (time of tensions relaxations) has a decisive influence on the stability at formation. For the synthetic leather semifinished products made up of one layer even the regime of stressing on the last, for 24 hours, leads to quite high values of the index, therefore an inadequate stability at formation. The 3rd and 4th regimes lead to results quite close in value; in other words, the stability of the spatial form of synthetic leather product on veil support

Table 2

h	The working condition				
	I	II	III	IV	V
1	1.78	0.39	0.22	2.11	0.15
2	4.05	1.18	0.79	3.39	0.40
3	4.94	1.90	0.92	4.02	0.55
4	5.78	2.25	1.01	4.25	0.68
5	6.60	2.70	1.05	5.14	0.70
6	7.15	2.98	1.18	5.68	0.72
24	10.02	5.35	1.22	6.92	0.90
48	11.30	6.32	1.28	6.98	0.91
72	12.27	6.78	1.36	7.07	0.94
96	12.70	6.84	1.42	7.16	0.96
120	13.15	7.20	1.45	7.25	1.02
144	13.40	7.65	1.49	7.28	1.10
168	13.60	7.80	1.56	7.30	1.15

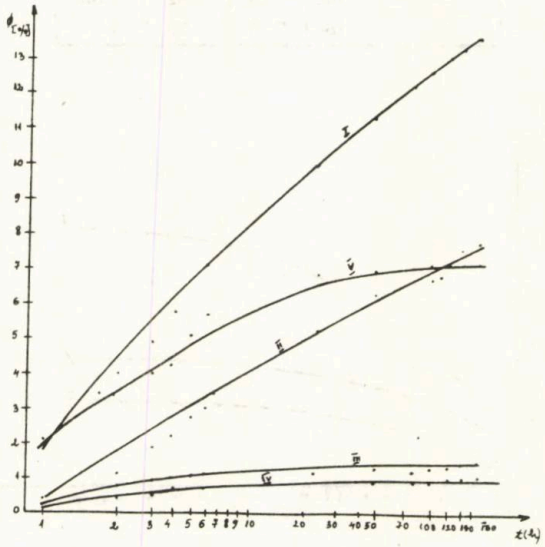

Fig. 2

and semifished thermally fixed at $\theta = 160°C$ and $t = 3$ min is close to that obtained by keeping the semifished product on the last for 7 days.

The structure of the semifished product influeces greatly the spatial formation stability. To exemplify Table 3 and Fig. 3 give the values of Φ index for semifinished

products with a differentiated structure made up of 1, 3 and 3 layers, respectively: 1 layer – unlined product; 2 layers – shuts + exterior lining; 3 layers – shuts + exterior lining + intermediary lining subjected to the fourth working regime.

Table 3

The working cond.	The semifinished product		
θ=160°C; t=3min.	1 layer	2 layers	3 layers
1	2.11	1.67	0.75
2	3.39	2.40	0.90
3	4.02	2.52	1.21
4	4.25	2.64	1.52
5	5.14	2.99	1.92
6	5.68	3.30	2.14
24	6.92	3.45	2.27
48	6.98	3.50	2.30
72	7.07	3.53	2.32
96	7.16	3.57	2.35
120	7.25	3.60	2.63
144	7.28	3.62	2.39
168	7.30	3.70	2.41

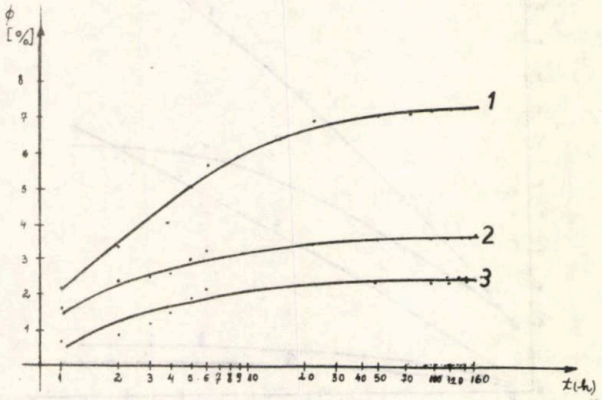

Fig. 3

The results show that the presence of the exterior linings (semifinished with two layers) determine a reduction of the Φ index by 2 times.

The presence of the 3rd layer in the in the structure of the semifinished product determines, after the same time interval a 3 times reduction of the Φ index value against the one layer semifinished (unlined status).

The stability of 2,3 layer semifinished under loading at $\theta = 160°C$ for $t = 3$ minutes is higher to that of the unlined one kepe under stress on the last for 24 hours.

Taking into account the results already mentioned in our study, the technologist will adopt depending on the structure of the semifinished, a regime of thermal duty apt to lead to a high stability in the spatial form of the footwear both in service and storage.

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STUDIU PRIVIND CONDUCEREA TEHNOLOGIEI DE FORMARE ÎN VEDEREA ASIGURĂRII STABILITĂŢII FORMEI

(Rezumat)

Se prezintă rezultatele privind studiul influenţei unor parametri tehnologici şi a structurii semifabricatului asupra fiabilităţii formei spaţiale.

Stabilitatea la formare a produsului a fost apreciată după gradul de modificare în timp a formei şi dimensiunilor unei secţiuni transversale reprezentativă pentru produs.

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TEXTILE. PIELĂRIE

PARTICULARITÉS ANATOMO-MORPHOLOGIQUES DES PIEDS DES PETITS ENFANTS ET DES ENFANTS N'AYANT PAS L'ÂGE SCOLAIRE

PAR
CORNELIA IONESCU et DAN FLORIN CROITORU

1. Introduction. À la base des projets rationnels des embauchoirs et de la chaussure il faudra se fonder sur les informations sur la construction anatomo-morphologique naturelle du pied, chose possible seulement par l'execution d'études anthropométriques.

Dans ce travail on présente une série de résultats obtenus à la suite d'une étude anthropométrique [1, 2, 3] effectuée par les auteurs sur un échantillon de 1400 enfants à partir de l'âge d'un mois jusqu'à sept ans, où l'on a principalement poursuivi les aspects suivants:

– la détermination de certains coefficients de proportionalité longitudinaux et transversaux des pieds;

– la détermination de la longueur de la plantogramme dans la zone la plus creuse du pied;

– la détermination de la forme des extrémités antérieures du pied;

– la détermination de la position du doigt I envers la tangente au contour intérieur du pied.

Les recherches anthropométriques ont établi que les dimensions longitudinales du pied sont proportionelles à sa longueur et que leurs points d'orientation sont situés dans la direction longitudinale à une certaine distance bien déterminée dans le sens de la longueur exprimée par le coefficient longitudinal de proportionalité. De même on a encore établi que entre les paramètres transversaux du pied il y a une relation de proportionnalité analogue à celle rencontrée aux paramètres longitudinaux qui s'exprime par le coefficient transversal de proportionnalité.

2. Résultats et commentaires. Dans le tableau 1 sont presentés les coefficients de proportionalité résultés des familles de corrélations provenus par l'analyse de regréssion des paramètres anthropométriques des pieds des sujets mesurés.

En analysant le tableau 1 on constate que les valeurs des coefficients de pro-

Tableau 1

Nr. crt.	Le coefficient de proportionnalité	La valeur du coef. de prop.: aux enfants	aux adultes
1	$K_1 = L_I/L_p$	0,715	0,720-0,730
2	$K_2 = L_V/L_p$	0,616	0,611-0,620
3	$K_3 = L'_V/L_p$	0,800	0,810
4	$K_4 = Pr/Pd$	1,044	1,044
5	$K_5 = Pc/Pd$	1,332	1,305
6	$K_6 = Pg/Pd$	0,992	0,950
7	$K_7 = ld/Pd$	0,430	0,420

où: L_p – la longueur du pied; L_I, L_V, L'_V – la distance du point extrême postérieur du pied jusqu'a l'articulation du doigt I, du doigt V, respectivement l'extrémité du doigt V; Pr – le périmètre du coup-de-pied; Pd – le périmètre des orteils; Pc – le périmètre au talon; Pg – le périmètre à la cheville; ld – la largeur des orteils.

portionnalité longitudinaux diffèrent très peu aux enfants par rapport aux adultes, tandis que les coefficients de proportionnalité transversaux sont plus grands aux enfants qu'aux adultes.

C'est un phénomène d'adaptation naturelle du corps humain, pour assurer le maintien de l'équilibre du corps donc il est normal qu'un pied ayant une plus petite longueur soit relativement plus large qu'un pied ayant une longueur plus grande.

Les valeurs inscrites dans le tableau 1 sont des valeurs moyennes établies à base de calcul statistique [4] et se rapportent exclusivement aux pieds moyens typiques.

Aux adultes, dans la zone la plus creuse du pied, la plantogramme occupe 40% de son gabarit.

Aux petits enfants et aux enfants n'ayant pas l'âge scolaire les résultats de l'étude [5] ont mis en évidence que la plantogramme occupe dans la même zone du pied, en moyenne 60% aux enfants âgés jusqu'à cinq ans et (42-44) % aux enfants âgés de cinq à sept ans.

La trace de l'empreinte plantaire plus grande pendant les cinq premièrs ans de vie est due aux caractéristiques anatomiques du pied de l'enfant qui se distinguent de celui de l'adulte; à partir du niveau des métatarsiens et en continuant avec les phalanges, les os ont une position radiale vis-à-vis de la ligne médiane de la plante, plus évident encore au nivéau du métatarsien I et des phalanges du doigt I, le calcanéum est faiblement développé, ayant une légère tendance vers le valgus, les articulations sont plus laxes encore, le tissu adipeux est plus développé.

Par la croissance de l'enfant, le pied se développe avec prédominance en longueur et se rétrécit relativement, les doigts commencent à s'approcher de la ligne médiane de la plante, la concavité de la voûte s'approche progressivement de la forme existante à l'adulte [6, 7].

En ce qui concerne la forme de l'extrémité antérieure du pied, à la suite d'un examen sur le contour tracé sur la fiche anthropométriques on a constaté l'existance des types suvants représentatifs du point de vue de la conformation [5]:

– pied dont le doigt I est plus long que les autres à 95,3% des sujets;
– pied dont le doigt II est plus long que les autres à 3,3% des sujets;
– pied dont les doigts I, II, III sont égaux à 1,2% des sujets.

En observant la position du doigt I vis-à-vis de la tangente tracée au contour intérieur du pied, on a fait la remarque que l'ongle formé a moyennement 5°pour 63% des sujets, (0-1)°pour 20,4% des sujets, 9°pour 10,6% des sujets, 13°pour 6% des sujets.

Ces valeurs [5] différentes de celles rencontrées aux adultes sont une conséquence des particularités anatomo-motphologiques du pied de l'enfant durant cette étape de vie.

3. Conclusions. L'étude des coefficients de proportionnalité du pied de l'enfant, de la forme ainsi que de la position des doigts et de l'empreinte plantaire contribue à l'éboration rationelle des projets des embauchoirs et des assortiments de chaussure dans le but d'assurer des conditions de confort maximum du pied et de préveni les malformations, dans la période où le pied de l'enfant est en plein processus de formation et de consolidation de son système osseux.

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PARTICULARITĂŢI ANATOMO-MORFOLOGICE ALE PICIOARELOR LA COPIII MICI ŞI LA PREŞCOLARI

(Rezumat)

Lucrarea prezintă rezultatele unui studiu antropometric efectuat la copiii mici ş preşcolari, în care s-au urmărit următoarele aspecte:
– determinarea unor coeficienţi de proporţionalitate longitudinali şi transversali ai picioarelor;
– determinarea lăţimii medii a plantogramei în zona cea mai scobită a piciorului;
– determinarea formei şi poziţiei extremităţilor anterioare ale piciorului.

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Secţia VIII
TEXTILE. PIELĂRIE

NEW COMPOSITE PREPARATIONS FOR THE IMPROVEMENT OF TEXTILES

BY

ANDREI MORYGANOV, ALEXANDER BARANOV, SVETLANA GUBINA and OLEG MESNIK

The basis for this work has been made by the systematic investigation which were carried out in our institute during the recent decade on:

– mechanism and efficiency of the plasticizing action of different compounds and their mixtures on fibre-forming polymers;

– state in solution, melt and reactivity of dyes and finishing preparations;

– mechanism of the interaction of dyes and textile auxiliary substances TAS with fibrous materials.

Generalization of the results of theoretical investigations allowed to formulate the following approaches to the development of liquid-phase compositions with predetermined properties (Fig. 1):

1) increase in the efficiency of plasticizing agents and selection of co-reagents acting on different structural elements of the fibre-forming polymers – for activation of fibrous materials during the processes of their dyeing, printing, stabilization of linear dimensions;

2) selection of catalysts, intensifiers and compositions consisting of the components which possess mutually additive action – for acceleration of chemical precesses when preparing the fibrous materials;

3) mechano-chemical activation (MCA), magnetic treatment (MT) or purposeful change in the colloidal state of disperse dyes and TAS in aqueous systems – for imparting new desirable properties to solutions.

It was created the intensifier based on potassium thiocyanate and urea for the fixation of reactive dyes or their mixtures with disperse ones on cotton-containing fabrics. It is called "Lakran". Firstly, the sinergism of the plasticizing action of these compounds on cellulose (due to the combination of the structural and molecular mechanisms of its plasticization) ensures an additional decrease in the vitrification temperature of cellulose under the conditions of thermo-treatment by

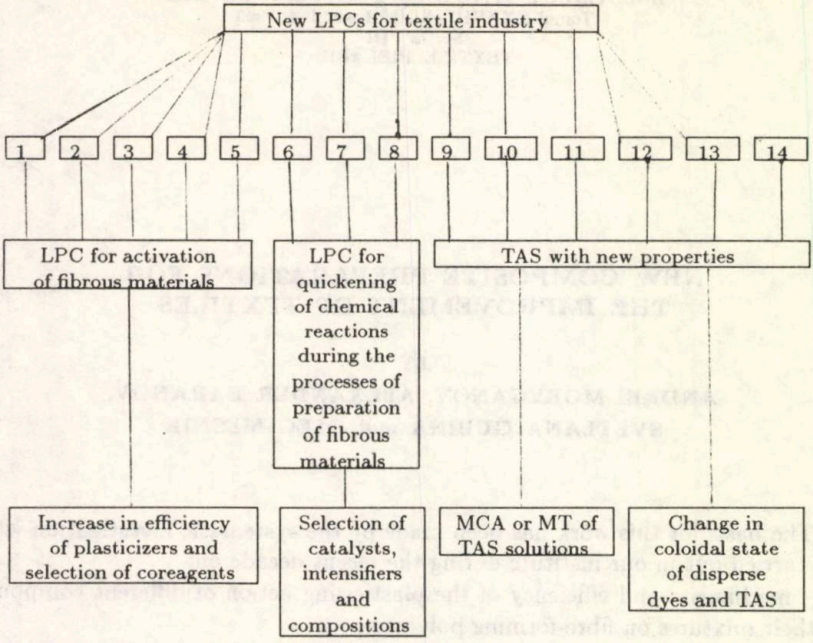

Fig. 1.– Scheme of creation of liquid-phase compositions (LPC) for textile material improvement. 1: triacetine+urea→colouration of TA, TA+PE; 2: benzyl alcohol+inorg. salt→colouration of PE; 3: diphenyl+inorg. salt→periodic dyeing of PE; 4: urea+inorg. salt→stabilization of PE, PE+cotton; 5: urea+KSCN→colouration of cotton; 6: Na_2S+NaOH+wetting→sizing of cotton; 7: aliphatic alcohols+NaOH+emulsifiers→mercerization of cotton; 8:"Rontex"→scouring of cotton (rongalit+complexon); 9: mechano-chemical activation (MCA) of aqueous suspension of disperse dye+textile auxiliary substance (TAS)→dyeing of PE, TA; 10: MCA of aqueous suspension of vat dye+TAS→dyeing of cotton, cotton+PE; 11: MCA of aqueous system of highly molecular thickeners→printing, sizing; 12: Magnetic treatment (MT) of alkali reduction solution→dyeing with vat dyes; 13: MT of the solutions of finishing preparations→non-crumpling and water-resistant finishing of cotton; 14: LPC for continuous dyeing of PE plait.

25-30°C, and, respectively, a sharp increase in the accessible free volume of fibre and dye fixation rate. Secondly, the stability of urea against thermal destruction grows considerably due to the change in the intermolecular interaction in the mixed intensifier melt.

As it is seen in Fig. 2, the temperature interval of the existence of stable intensifier melt grows from 36-40°C to 138-140°C (in comparison with pure urea – the most widely used intensifier for the reactive dye fixation). It is also noteworthy (Fig. 3) that isocyanic acid, which is formed at thermal decomposition of urea, neutralizes the alkali reagent, lowering considerably pH of the dyeing composition (curves *3, 4*) and, thus, preventing the process of the fixation of reactive dyes by fibre. Mixed plasticizer urea – potassium thiocyanate (Fig.3, curve *2*) allows to

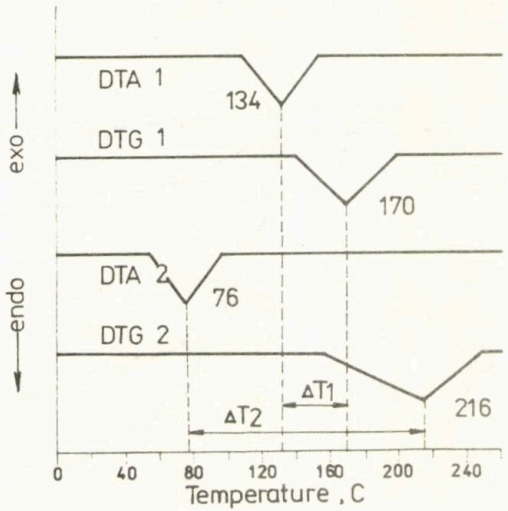

Fig. 2.– DTA and DTG curves for urea (1) and binary mixture urea-potassium thiocyanate (2). ΔT_1 – temperature interval of the existence of stable urea melt; ΔT_2 – temperature interval of the melt of binary mixture urea-potassium thiocyanate.

preserve the required level of pH of the dyeing composition (9.8-10.3) over a wide temperature region (140-200°C); this ensures a higher degree of fixation of reactive dyes and improvement in the qualitative parameters of dyeing.

For instance, when colouring the cotton-polyester fabric (Table 1), the highest yield of both reactive dye on cotton fibre and of disperse dye on lavasan is achieved; as a result, the best evenness of dyeing is obtained. Besides, a sharp decrease in isolation of the products of urea decomposition (last column in Table 1) improves essentially the sanitary-hygienic labour conditions at thermo-treatment and lowers the equipment pollution.

Table 1

Influence of plasticizers on dyeability of cotton-polyester fabric

Plasticizer	Dye content in textiles, g/kg			Total fixation degree, %	Reducing of urea decomposition products at curing, g/10 m^2 of fabric
	Total	Reactive dye on cotton	Disperse dye on polyester		
Urea	12.7	10.4	15.9	73	82
Urea/potassium thiocyanate mixture	16.3	15.1	17.0	86	23

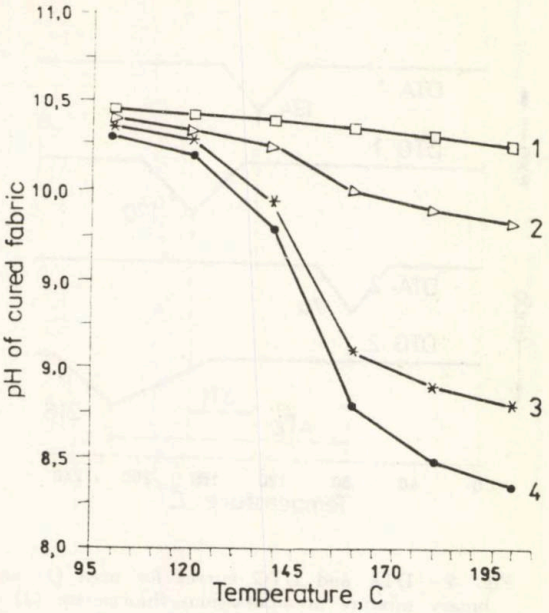

Fig. 3.– Influence of thermo-treatment temperature and plasticizers on pH of the dyeing composition. *1* – sodium carbonate 1.5%; *2* – sodium carbonate 1.5% + urea 5% + potassium thiocyanate 5%; *3* – sodium carbonate 1.5% + urea 5%; *4* – sodium carbonate 1.5% + urea 10%.

The extended industrial tests of "Lakran" preparation confirmed (Table 2) that the colouring intensity required is achieved even at smaller amounts of the printing dye applied to the fabric due to 10-26% increase in the dye fixation degree. The intensifier proposed is universal both from the viewpoint of the fixation method (hot air, over-heated and saturated water vapour), and taking into account the classes of dyes (reactive, vat, disperse and their mixtures) and ensures a considerable improvement in the technico-economic and ecologic parameters of the process of colouring of fabrics.

Investigations on the specificity of the physico-chemical processes occuring in heterogeneous system fibre-admixtures-TAS solution when preparing the cellulose textile materials allowed to find the theoretical preconditions of the purposeful selection of intensifiers and catalysts. On this basis, we have developed new compositions for the selective action on the admixture components or cellulose during the processes of boiling and bleaching of fabrics.

"Rontex" is the first of such preparations; its ingredients ensure the required completeness and rate of isolation of cellulose admixture while inhibiting safely its destruction. The practical work of the textile enterprises of concern "IvTEX" showed that the application of "Rontex" allowed a flexible regulation of the processes

Table 2

Results of industrial tests of "Lakran" employment

Dyestuff (Fabrics)	Dye contents in textiles after printing g/kg	Fixation conditions			
		Saturated steam		Superheated steam	
		Dye content in textiles g/kg	Fixation degree %	Dye content in textiles g/kg	Fixation degree %
Reactive Green 4Y + Reactive Turquoise Blue 2GT (satin)	1. 56.6 2. 48.8	40.5 43.1	72 88	39.6 42.3	70 86
Reactive Red 6B (satin)	1. 61.4 2. 46.5	31.2 27.2	51 59	35.1 40.4	57 87
Reactive Red 6B + Ostazine Orange H2R (mitkal)	1. 34.0 2. 32.4	24.8 26.7	73 82	23.8 27.4	70 85
Reactive Green 4Y (satin)	1. 36.0 2. 31.0	– –	– –	23.5 26.8	65 86
Reactive Violet 2RT (mitkal)	1. 40.1 2. 36.4	30.5 31.1	76 85	28.2 29.7	70 82
Reactive Black 4BT (mitkal)	1. 38.8 2. 33.8	29.7 28.1	77 83	27.1 26.5	70 78

1 – urea (100...150 G/L);
2 – "Lakran" (80...100 G/L).

of preparation in the dependence on the assortment and purpose of the fabrics (Fig. 4), 1.5-2 time decrease in the duration of boiling and exclusion of the acidic treatment of fabric. Application of "Rontex" ensures a high quality of preparation (Table 3): whiteness 82-87%, capillarity 150-180 mm at high degree of cellulose safety (specific viscosity 1.67-1.87), 10-40% increase in dyeability for various classes of dyes and simultaneous improvement in the evenness and fastness of shades by 0.5-1 point.

Table 3

Efficiency of application of "Rontex" to the process of boiling of cotton fabrics

Boiling composition	Duration of boiling, min	Degree of removal of admixtures, %	Capillarity, mm/60 min	Whiteness, %	Specific viscosity	Relative dyeability of fabrics with dyes, %
Traditional	120	62	120...130	82...83	1.5	100
With "Rontex"	60	72	150...180	82...87	1.7...1.9	Vat:117...131 Reactive:110...115 Cold:123...142 Sulfur:120...122

The boiling solutions include only alkali, "Rontex" and wetter; this simplifies substantially the process of preparation of the feeding solutions at the chemical

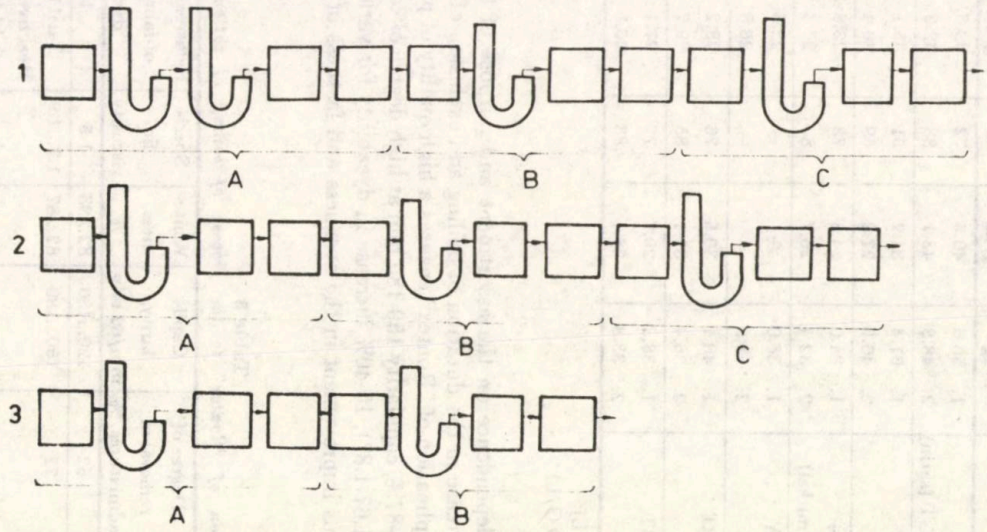

Fig. 4.– Technological schemes of the processes of preparation of cotton fabrics using "Rontex".
1 – Existing technological scheme: *A* – Scouring; *B* – Treatment with acid; *C* – Bleaching.
2 – New technological scheme – for preparation of linen white – background fabrics: *A* – Scouring; *B* – Treatment with acid; *C* – Bleaching.
3 – New technological scheme – for preparation of fabrics for dyeing and cloth print: *A* – Scouring; *B* – Bleaching.

stations of the bleaching shops. Bleaching with "Rontex" ensures the 30% decrease in the expenditures of water, vapour and electric energy.

A new organic stabilizer "Belotex" has been developed for the processes of peroxide bleaching. In efficiency and reliability of the action it does not yield to sodium silicate and makes it possible to exclude the latter completely in continuous alkali-steaming methods of bleaching.

Rongalit is known to be the most widely used reducer when printing with vat dyes. However, it is thermally non-stable and decomposes at drying and further conditioning of the printed fabrics. Its losses reach 50% and more, which results in a lowered quality of printing or necessity of redundant introduction of the reducer into the printing dyes. Our investigations have revealed the possibilities of increasing the thermal stability of rongalit and stabilization of its redox potential. This allowed to obtain a new composite liquified reducer "Roncol" which is aimed at substituting rongalit during printing on fabrics with vat dyes. The industrial tests of "Roncol" confirmed that it ensured high colouristic parameters of shades (demonstration of examples) while its expeditures are 2-3 time lower than of rongalit. This is the proof of its economic advantage. Besides, the application of the new preparation simplifies considerably the process of preparing the printing dyes due to the exclusion of the stage of boiling of rongalit powder, improves the sanitary-hygienic labour conditions.

We have developed a low-formaldehyde preparation on carbamide-formaldehyde basis for low-crumplig and low-shrinkage finishing of fabrics of natural and regenerated cellulose fibres which is used for final finishing of fabrics. It is called "Carbamol MT-2" and is now at the stage of commercial production. It is a mobile liquid easily mixible with water and very convenient at dosing out and preparing the technological solutions. Variation of "Carbamol MT-2" composition at the expense of the change in synthesis conditions regulates the ability of the preparation to linear polymerization and crosslinking formation. This allows to use it for various types of finishing of cellulose-containing fibrous materials: MARS (low-wash-out dressing by reactive pitches), PUKhO (antishrinkage chemical finishing), SShO (silvery-silky finishing), LG (soft ironing), MS (low-crumpling finishing).

"Carbamol MT-2" passed the industrial tests at textile factories of Kostroma, Ivanovo, Kokhma and some other cities. The results obtained are shown in Table 4.

It is seen that in comparison with Carbamol CEM, the new preparation ensures a better non-crumpling of fabric: de-crumpling angles for "Carbamol MT-2" are by 12...15 degrees larger than for Carbamol CEM and exceed by 30 degrees the requirements of GOST. Besides, domestic shrinkage of fabrics decreases in 3 times, which is also considerably better than GOST normatifs. The decrease in the durability of the textile material after finishing with "Carbamol MT-2" is not large (5...15%) and somewhat lower than that for Carbamol CEM. Thus, "Carbamol MT-2" ensures good quality of finishing, which is higher than the requirements of the corresponding standards.

"Carbamol MT-2" manifests its advantages the most visually as a low-formal-

Table 4

Results of industrial tests for "Carbamol MT-2"

Parameters	Non-treated fabrics	Carbamol CEM	Carbamol MT-2	GOST
Non-crumpling index, grad:				
– in dry state	–	181	193	200
– in wet state	–	215	230	200
Change in linear dimentions of fabric after washing, %				
– warp	-4.6	–	-1.6	-3.5
– weft	+2.7	–	+1.7	+2.0
Tensile strength of fabric stripe 200×50 mm, Kg				
– warp	38.2	37.0	39.1	–
– weft	21.5	17.8	19.0	–
Formaldehyde concentration in the air at production sites, mg/m^3				
– padding	–	0.47	0.32	–
– weft correction	–	0.47	0.18	–
– auto-stacking	–	0.29	0.14	–
Free formaldehyde concentration on fabric, ppm	–	3000-4000	0-300	–

dehyde preparation. The content of formaldehyde in the air of the industrial sites is 2-4.5 time lower than when using Carbamol CEM. Application of "Carbamol MT-2" allows a 10-20 time decrease in the concentration of free formaldehyde on fabric in comparison with Carbamol-2 or Carbamol CEM. Some experimental batches of the new preparation ensure complete absence of formaldehyde on the finished fabrics.

The results achieved allow to use "Carbamol MT-2" for the production of fabrics with improved sanitary-hygienic parameters. The application of "Carbamol MT-2" is especially perspective for the finishing of the fabrics children and linen.

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FORMULE COMPLEXE DE AUXILIARI PENTRU ÎNNOBILAREA TEXTILELOR

(Rezumat)

Se prezintă în mod sintetic activitatea de elaborare a noi auxiliari pentru finisarea materialelor textile.

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TEXTILE. PIELĂRIE

BASICS AND PRACTICAL APPLICATION OF MAGNETIC TREATMENT FOR VAT DYEING OF COTTON TEXTILES

BY
SERGEY KOKSHAROV, VLADIMIR IVANOV and BORIS MELNIKOV

The influence of magnetic field on redox reactions and mass-exchange processes in 3-phase system "gas-liquid-crystal" is estimated using the example of the solutions of sodium hydrosulphite and of vat dyes. The results of the fundamental investigations form the foundation for the perfection of the technologies of fabrics dyeing using vat dyes.

Hydrosulphite $Na_2S_2O_4$ – sodium dithionite (SDT) according to chemical terminology – is the main reducer for the dyeing with vat dyes. Its merits are cheapness and accessibility, fault – liability to oxidation with molecular oxygen; as a result, the reducing activity of the technological compositions decreases, and reproductivity of the reduction results becomes worse. There is an attempt at creating the reduction composition based on SDT with higher stability against oxidation with oxygen.

The amount of dissolved oxygen in water is $(2.5...5.0)\cdot 10^{-4}$ mol/l. At dissolution, SDT reacts with the dissolved oxygen; the reaction has the first order for both reagents (1):

$$W = k \cdot C_{\text{oxygen}} \cdot C_{\text{SDT}} \tag{1}$$

The dependence below is true over the temperature interval from 278 to 298°K:

$$\ln k = 51.3 - 11369/T \tag{2}$$

The activation energy is 95.4±3.4 kJ/mol. At 20°C ($C^0_{\text{oxygen}} = 3.4 \cdot 10^{-4}$ mol/l, $C^0_{\text{SDT}} = 0.2$ mol/l). $W \approx 16$ mol/s, i.e. the entire oxygen dissolved interacts with SDT practically immediately. Further oxidation of SDT is done by the oxygen coming into the solution from air. Chemosorption of the atmospheric oxygen is described using the model of the modified film model of mass-exchange which is complicated by the occurance of the chemical interaction. It is calculated that the

reaction of SDT with the atmospheric oxygen proceeds within the surface layer (0.25 mm thick) of the liquid; here, the absorption rate is 3 order lower that the rate of the chemical interaction itself, i.e. SDT oxidation with oxygen is limited by the inter-phase mass-exchange. It is established that the state of the liquid surface has a considerable influence on the oxidation rate of SDT. For instance, if there is a surface layer of alkanol (C_2...C_4), that is characterized by high solubility of oxygen, the oxidation becomes 2...5 times quicker. On the contrary, the surface isolating film of surface-active agents (SAA) opposes the absorption of oxygen and hinders SDT oxidation by 15...60%.

It was not possible to use SAA as the antioxidant of SDT during the vat dyeing because of the 15...20% decrease in the degree of dye fixation. Two reasons for the worsening of the dyeing quality are possible: firstly, possessing washing properties, SAA favours the desorption of non-fixed suspension of the vat dye into the reducing solution and the rinsing waters; secondly, while concentrating on the surface of the reduction composition, SAA prevents the contacts of the dye particles with SDT, as a result, the complete, qualitative reduction of the dyeing substance is not achieved. Thus, for the effective stabilization of SDT with the preservation of the good quality of dyeing, it is necessary only labilly, reversibly (for the period of storing before usage) to increase the inter-phase resistance of the reduction solution.

Introduction of any chemical reagents modifies the properties of liquid irreversibly. The reversible change of the state can be achieved at the action of constant magnetic field onto the solution. Numerous properties of liquids change at magnetization, these change being preserved in immobile or laminar flowing liquid for several hours after the end of the magnetic action. Stirring (turbulization) removes the magnet-initiated deviations in the state of solutions nearly immediately.

Proposed is the composition containing the product of oxyethylation and oxypropylation of phenol (hereafter called "preparation F") for the temporary change in the surface resistance of solution resulting from the magnetic action. Preparation F does not posses washing properties, and forms homogeneous mixtures with water. Fig.1 shows that introduction of preparation F into the reduction composition in the amount of 0.25...0.5 g/l without magnetic action makes SDT oxydation slower only by 9...12% (curve *1*). After magnetization of the reduction composition, that contains preparation F, the oxidation of SDT becomes slower by 40...45% (curve *2*); this, evidently, occurs due to the concentration of preparation F on the surface of liquid, similarly to SAA. However, contrary to SAA, this magnet-initiated fluctuation of the concentration can be removed by the mechanical action onto the solution (e.g., stirring). After that, preparation F does not exert the negative influence on the interaction between SDT and dye, since in nonmagnetized state it does not posses either washing or insolating properties.

The optimum parameters of the stabilization of the reduction composition are determined on the basis of the experimental data:

- contents of preparation F is 2...3 g/l;
- temperature of the solution is not higher than 30°C;
- magnetic field tension is 120 kA/m;

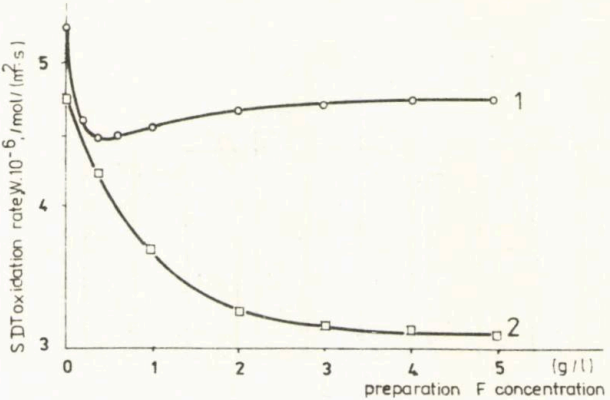

Fig. 1.– Influence of the magnetic treatment at field tension 120 kA/m and of preparation F concentration on SDT oxidation rate *1* – without magnetization; *2* – with magnetization.

– duration of the magnetic action is not less than 20 sec.

The above parameters of the magnetic treatment can be applied to the conditions of industrial production using the communicating magnetizing apparatus, which is established in the entrance tubing before the vessel with the reducing composition. When stored, the solution is in magnetized stabilized state; here only 20% of SDT is oxidized during 6 hours, while in non-stabilized solution, the reducer loss reaches 40%. When the composition is pumped into the padder, the magnet-initiated change are removed due to the stirring of the liquid, and preparation F looses SAA-like properties.

As it is shown in Fig.2, the application of the stabilized composition improves the reproduction of dyeing in several times: for example, the dye fixation degree on fibre after the storage of the traditional composition for 6 hours decreases by 9%, but only 1.5% when the composition proposed is used; the reproduction of the colouristic characteristics – lightness and depth of shade – improves equivalently. Proceeding from the results obtained, we recommmend that the magneto-chemical composition developed should be widely used for the dyeing of fabrics.

Vat dyes in oxidized quinone form are entirely insoluble in water and, hence, form heterogeneous systems in it – hydrosols. It has been found using the example of 9 dyes of indigo-like and polycyclic structure in different forms (powders, pastes) that in hydrosols, there is a slow spontaneous enlargement of particles; this results in the increase in their dimentions by 10% during 24 hours. The magnetic treatment fastens this natural process in 100...1000 times. In the magnetic field with the tension of 120 kA/m, the dimensions of dye particles increase by 5...40% during 5 min. This effect is exhibited even in real dyeing compositions containing dispersants. After the magnetic treatment, precipitation of the suspended particles becomes faster by 20...70%, this is conditioned to equal degree both by the

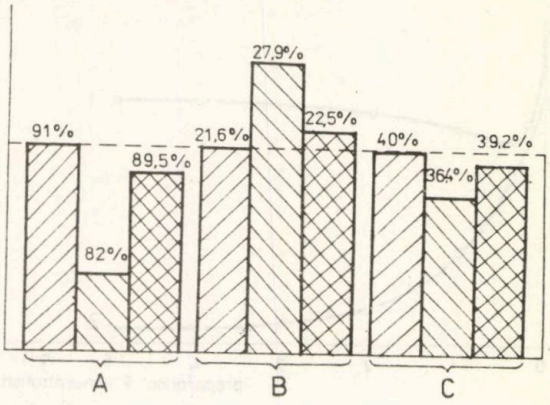

Fig. 2.– Characteristics of dyeing of fabrics reps art. 3161 using vat dye brightly-green G.

enlargement of particles, and by the change in their morphology.

When the fabric is dried after impregnation with the dyeing composition, the dye particles migrate to the evaporation surface, due to which the dyeing unevenness increases. It is proposed to inhibit the migration due to the magnet-initiated enlargement of the dye particles. 3 variants of magnetation are compared: treatment of the dye suspension before impregnation; magnetation of the suspention and fabric during impregnation; and magnetation of the wet-wrung fabric that is impregnated with the suspension. Magnetic treatment of the wet-wrung fabric yields the best results: for various dyes, the migration coefficient (the objective index of the dyeing unevenness) becomes 1.1...1.5 times lower; here, the effectiveness of the magnetic action increases with increasing field tension (over 20...200 kA/m interval). The optimality of the wet-wrung fabric is explained by that in this case the enlargement of the dye particles occurs directly within the material volume, while at other variants of magnetation, the mechanical actions on the suspension (stirring, impregnation) level the effect of magnetic aggregation.

Technological water and solutions always contain admixtures – predominantly salts of alkali-earth and d-metals. In their presence, the clearness and intensity of the shadows obtained decreases by 10...15%. Chemical softening of water before the preparation of the solutions is expensive and not effective enough, since the fabric also contains considerable amounts of admixtures, especially iron compounds. It is found that the magnetic treatment of the reduction solution prevents from the formation of non-colour, possessing no affinity to the cellulose fabric calcium, magnium, zink, cadmium, iron – and copper – containing salts of leucoacids of the vat dyes; here, the losses in the dyeing intensities become 2.4...3.4 times lower, and the total difference in colours decreases in 1.2...2.5 times. Thus, the magnetic treatment allows to prepare the reduction solutions base on hard water.

The study of quinone – hydroquinone transitions of the vat dyes and of the

influence of the magnetic field on them is of great theoretical and practical signifiance. At the same time, the existing data on the kinetics of these processes are of qualitative (quicker – slower) or semi-empirical (time of half-dyeing) character. Strict kinetic characteristics (rate constants) are practically absent, which is, evidently, explained by the complexity of distinguishing between the characteristics of the separete stages of the processes in the integral kinetic curve. We have made an attempt at overcoming the above difficulty using the non-linear regression analysis.

The method of gradient was used. The interaction procedure helped to calculate the values of the rate constants ensuring the best approximation of the calculated kinetic curve to the experimental data. The approximation quality was estimated from the values of the weighed sum of the deviation squares (ψ). The method is written down as FORTRAN-language program for IBM PC/AT286 computer.

The calculation was carried out for two possible mechanisms of the quinone – hydroquinone transitions – irreversible (3) and reversible (4):

$$\text{oxidized dye} \xrightarrow{K_1} \text{reduced dye} \tag{3}$$

$$\text{oxidized dye} \underset{K_2}{\overset{K_1}{\rightleftharpoons}} \text{reduced dye} \tag{4}$$

Table 1 carries the values of the calculated constants and weighed sums of deviations (ψ) for both alternative mechanisms. Since the weighed sums of the deviation squares for the irreversible process exceed 10^{-2}, then we might conclude that equation (3) does not correspond to the real procedure of the reaction. On the other hand, values for the reversible quinone – hydroquinone transition are close to zero and by 1...2 order lower than those for the irreversible reaction; thus, the process can be described adequately by equation (4). This testifies to that even if great amount of the reducer is available, the oxidation of the dye's hydroquinonic form (leucoacids) proceeds simultaneously with the reduction of the dye. The atmospheric oxygen, that is absorbed by the liquid, acts as the oxidizer. The oxidation rate found is by 1 order higher than the reduction rate; this is in good agreement with the empirical data on the duration of oxidation and reduction of the vat dyes at their industrial application. The values of the equilibrium constants (K_{eq}) are below 1, i.e. the equilibrium is displased towards the oxidized quinonic form the dye. It is found that the reduction of the vat dyes becomes quicker in the magnetic field, this process increasing with the increase in tension from 2...13% at 60kA/m to 17...44% at 180 kA/m. Simultaneously, the oxygen oxidation of leucoacid becomes quicker:the quickering effect is 12...24% at 180 kA/m; as a result, the equilibrium constants change insignificantly.

The method of potentiometric titration helped to distinguish the kinetic characteristics of quinone – semiquinone and semiquinone – hydroquinone transitions. It turned out that the procedure of the former transition does not practically change; the magnetic treatment activates mainly the transition from semiquinone

Table 1

Results of the non-linear regression analysis

Vat dye	Magnetic field tens. kA/m	Irreversible mechanism		Reversible mechanism			
		$K_1 \cdot 10^2$	ψ	$K_1 \cdot 10^3$	$K_2 \cdot 10^2$	ψ	K_{eq}
Green G	0	1.11	0.0323	0.70	1.24	0.0002	0.0566
	60	–	–	0.79	1.25	0.0007	0.0632
	120	1.43	0.0250	0.96	1.52	0.0005	0.0632
	180	–	–	1.01	1.55	0.0010	0.0652
Green S	0	1.42	0.2860	3.69	1.26	0.0041	0.2929
	60	–	–	3.77	1.29	0.0056	0.2922
	120	1.58	0.1231	4.12	1.39	0.0048	0.2964
	180	–	–	4.32	1.42	0.0059	0.3042

into hydroquinone and backwarf; the increase in the redox buffer of this transition in 1.4 times corresponds to this.

Thus, in the kinetic aspect, the magnetic action on the quinone – hydroquinone transitions is similar to the influence of a catalyst, since both direct and reverse reactions become quicker.

The technology of the continuous suspension dyeing of fabrics presupposes a short-time (1...2 min) reduction of the vat dyes in oxygenless medium. Under such conditions, the application of the magnetic activation is justified and expedient, since oxidation is absent and the magnetic field quickens only the reduction process ensuring a quick achievement of complete reduction of the dye.

It is found under the laboratory conditions that the magnetation of fabric with drifted suspension of the vat dye and of the reducing solution during impregnation is the optimum way of the magnetic activation of the reduction. To realize this method of the magnetic treatment, we have developed a semi-industrial apparatus (Fig.3) which is characterized by increased ecologic and sanitary security. At 200 kA/m field tension in the electromagnet clearance, the value of the background magnetic field does not exceed 0.1...0.2 kA/m at 0.5 m distance from the apparatus, wich is tens of times lower than the maximum admittable values (normative in Russia is 8 kA/m).

The technology developed is tested in the textile factories of "IvTex" concern (Ivanovo, Russia). The data of Table 2 demonstrate the effectiveness of the magnetic activation: the dye fixation degree and its amount of fibre increase by 9...10% due to the improvement in the conditions of reduction and diffusion at the magnetic action. The effect found allows to decrease the reagent concentration in the technological compositions.

Magnetation compensates for a 25%-decrease in SDT content in the developing solution, the intensity of the shadows obtained being only by 0.1 K/S units smaller than at developing with the traditional composition. Such a difference is not detectable visually. Due to the magnetic activation, the dye is spent more rationally, and it is possible to lower its content in the impregnation bath from 30 to 25 g/l

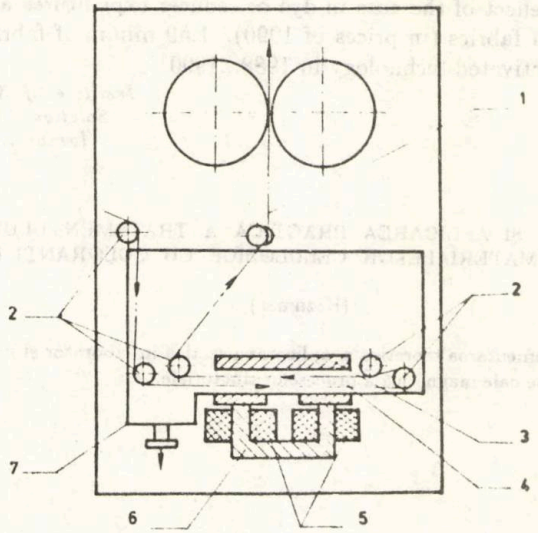

Fig. 3.– Semi-industrial apparatus for magnetic treatment fabric and solution during impregnation *1* – fabric; *2* – rollers; *3* – electromagnet; *4* – electromagnet clearance; *5,6* – electromagnet; *7* – bath for solution.

Table 2

Results of the industrial tests of the magnet-activated vat dye dyeing technology

Dye concentration, g/l	Reducer concentr., g/l	Magnetic field tens., kA/m	Dyeing intensity, K/S units	Dye content of fibre, g/kg	Dye fixation degree, %
30	35	0	8.7	25.6	81
		160	9.1	28.2	90
30	26	0	8.2	22.6	71
		160	8.6	25.4	81
25	35	0	8.1	22.1	83
		160	8.6	25.0	94

(by 17%) without worsening of the quality of the shadows obtained. The fixation degree of the dyeing substance increases from 81 to 94% and, correspondingly, the rinsing water becomes less polluted.

The economic effect of the cuts in dye or reducer expeditures achieves 30000 rbl. per 1 mln.m of fabrics (in prices of 1990). 1.59 mln.m of fabrics were dyed using the magnet-activated technology in 1988...1990.

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FUNDAMENTAREA ŞI APLICAREA PRACTICĂ A TRATAMENTULUI MAGNETIC LA VOPSIREA MATERIALELOR CELULOZICE CU COLORANŢI DE CADĂ

(Rezumat)

Se prezintă fundamentarea teoretică şi aplicarea practică în laborator şi în industrie a metodei de intensificare pe cale magnetică a proceselor tinctoriale.

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THE RHEOLOGICAL CHARACTERIZATION OF SOME CARBOXYMETHYL-CELLULOSE-BASED AGGLUTINANTS

BY
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C. LUCA, N. NAUM and ANCA MOISE

1. Introduction. The print pastes differ from the dye baths especially by the presence of an agglutinant which provides the viscosity necessary to the printing process, essential for the localization of dyeing. Different agglutinants or their mixtures are being used function of the nature of the material, dye class and printing process. The establishing of the optimum formula of the paste is usually done by comparative printings.

The rheological researches presented in the specialized literature show that most print pastes display a pseudoplastic flow. A certain force must act on some of them so that the flow could take place; therefore, they have a limit stress, characteristic to the plastic fluids. For instance, the starch-made pastes have a plastic flow and a thixotropy phenomenon [2], methylcellulose, carboxymethyl-cellulose, guar gum, carboxymethyl-starch etc. produce pastes with pseudoplastic fluids characteristics [1], acacia gum and polyvynil alcohol-based agglutinants produce pastes behaving as Newtonian fluids [1, 2, 3]. The best agglutinants for practical purposes have similar physico-mechanical properties and differ only by the values of the rheological characteristics [4]. However, for every agglutinant there exists an optimum concentration value which corresponds to a definite degree of structure to which the system has a pseudoplastic behavior similar to printing [5].

In the printing practice, the pastes are empirically characterized by the term "long" or "short" function of the flow behaviour determined by visual observation. In this case the comparison of the paste flow from "pan" is being done. Thus we can consider that at such a determination, the shearing rate gradient is $D = 10$ s^{-1}. By correlating these characteristics with the mode of rheological behaviour, we find out that a Newtonian paste is extremely "long", a Newtonian paste which has not a limit flow stress is relatively "long" while one which has a limit flow stress is "short". But these characteristics have not got any importance for the Newtonian behaviour as the value $D = 10$ s^{-1} does not correspond to that which

intervenes in the fluid in the moment of printing.

Practice shows that the success of a printing depends to a great extent on the viscosity of the used pastes, on its variation function of the shearing rate gradient. That is why the visual appreciation of the paste consistency to another value of D than that which actually intervenes in printing is not conclusive for the printing behaviour. For a proper scientific appreciation, the knowledge of the effective shearing rate gradient D_{ef} which corresponds to the shearing stress during printing, is imposed. On the rheological curve, the value of τ is determined by means of D_{ef}, and then the apparent viscosity of the paste in the moment of its application on the textile material on which the success of the printing depends, is found out.

Many papers [1, 3, 6] try to determine the value of D_{ef}. For the film-screen printing, W i c k and S c h u t z established a value ranging between 50 and 200 s^{-1}. It is shown that in spite of the apparent lack of precision, this result has a practical interest. It indicates the precise order of magnitude if the large scale of the shearing rate gradients which are used for the rheological characterization is taken into account. This order of magnitude helps to the proper selection of the rheometer, so that it should allow the research in the domain which is of interest from a practical view point. Thus, the necessity of knowing the working rheological conditions during printing is being imposed.

In what the roller printing is concerned, the D_{ef} values presented in different works do not agree one with the others. Thus, M ü l l e r [3] gives values ranging between 5,000 and 10,000 s^{-1}, while W i c k and S c h u t z show that the shearing rate gradient depends on the working conditions (roller engraving, pressure, printing speed, nature and state of the woven fabric), and thus giving values ranging between 350 and 30,000 s^{-1}; at the same time, they specify that the precision of the determinations is relatively reduced.

Researches have been done to establish the relation between the apparent viscosity corresponding to D_{ef} and the properties of the prints (the amount of paste shifted on the woven fabric, the contrast, the fineness, the penetration, the tinctorial efficiency). The paste penetrates more or less into the woven fabric during printing.

Thin pastes give better results during printing as compared to the thick ones, on the condition that the diffusion phenomenon of the dyer should not appear.

That is why, the more accentuated the decrease of viscosity under the influence of the shearing strain is, the better the penetration effect will be. Therefore, the decrease of the dyeing paste viscosity usually has positive technological effects, but sometimes negative ones, especially for high rotating speeds of the engraved rollers or of the rotative gauges where high shearing stresses – up to 10,000 dyn/cm^2 are registered [4].

The presence of a smaller agglutinant quantity in the paste makes possible a better adherency of the dye on the fibre. Its diffusion and fixation are easier done under these conditions. One might think that the thixotropic and plastic pastes should give well-defined contours, thus not to be diffused because of their high viscosity at small values of D.

One could note that often just these pastes diffuse as they stay on the surface of the woven fabric owing to the structure of the gel while an acacia gum paste – with a small viscosity – penetrates quickly into the fabric and have not got the time to be diffused outside the pattern.

On correlating the rheological properties with the behaviour of the starch paste during printing, it results that the paste presents both a plastic flow and thixotropy phenomena and ensures a good tinctorial efficiency but a reduced uniformity [2, 7...10].

Relatively large amylopectin particles from the swollen starch paste do not allow a too fine dispersing of the dye, the latter remaining on the surface of the woven fabric together with the agglutinant particles which from a "screen". That is why, if the paste amount deposited on the surface is increased, the contrast is also increased. The presence of large amylopectin particles whose branches interpenetrate and form swollen structure which retain as well a great quantity of water, explains the thixotropic phenomenon of the starch paste.

The "screen" effect is strengthened when one uses agglutinants with a very large structure of the particles, when the viscosity of the paste is very great, when the content in dried substance of the paste is great and when the woven fabric does not present hygroscopicity. This "screen" effect was found in starch and carboxymethyl-starch [1]. But if one uses a paste of an agglutinant with smaller water-soluble molecules, e.g. the acacia gum – which can have as well a role of protecting colloid –, the dye will be very finely dispersed and the paste will better penetrate into the woven fabric but with a reduced tinctorial efficiency [2]. Thus, the diffusion of the dye into the material which influences the precision of the contour as well as the penetration degree are determined not only by the viscosity of the paste but also by the structure of its particles.

The accomplished researches have shown that a paste which presents a flow limit and a linear rate of the rheological curves (as for instance, the acacia gum) has good printing properties [2]. That is why, an extremely "short" paste prepared with a synthetic agglutinant (Lutexal U) gives successful printings and a good uniformity especially for large surfaces.

2. Experimental Part. For the rheological study of the pastes obtained from products based on chemically transformed carboxymethyl-cellulose, the O s t w a l d de W a e l e mathematical relation of the following from is recommended:

$$\tau = K \cdot D_r^n \quad \text{or} \quad \eta = K \cdot D_r^{n-1}$$

where: τ = shearing stress (dyn/cm^2)
D_r = shearing rate (s^{-1})
η = apparent viscosity (cP)
n = flow index
K = consistency index.

By looking up the logarithm, one can obtain:

$$\lg \tau = \lg K + n \lg D_r$$

i.e. the equation of a straight line where $\lg K$ is the ordinate at origin, n is the slope of the straight line. The rheological behaviour of the studied products was discussed by the curves which represent the variation of the viscosity function of the shearing stress and the valeus of the flow index.

Laboratory experiments have been done by which the variation of the pastes viscosity function of a series of parameters which intervene in the process of their preparation has been studied. We have tried to deal with: the concentration of the agglutinant paste, the storage time of the pastes, the nature of addition salts, as compared with imported reference agglutinants, namely, Indalca PA-3 and Manutex (sodium alginate).

The pastes from the studied products have been prepared by mixing the agglutinant at cold under stirring; with the water quantity necessary to be brought to the desired concentration, homogenous, translucent pastes being obtained. We have analysed some products which differ both by the characteristics of the initial carboxymethyl-cellulose and by the type and concentration of the modifying substance (Table 1).

Table 1

Product	Chemical structure	Conc. %	No. Figure
Indalca PA-30	Modified natural gums	8	1 (curve *1*)
Manutex	Sodium alginate	5	1 (curve *2*)
I	Technical CMC	10; 12	2 (curve *2; 1*)
II	Pure CMC	5	2 (curve *3*)
IV_A	II-nd modified with sodium hydrogen phosphate	7	3 (curve *1*)
IV_S	II-nd modified with sodium hydrogen phosphate	6	3 (curve *2*)
V_S	I-st modified with urea	10	4 (curve *1*)
VI_A	II-nd modified with urea	7	4 (curve *2*)
XI	I-st modified with urea	5	5 (curve *1*)
XII	II-nd modified with urea	5	5 (curve *2*)

The rheological measurements have been done with a concentric cylinder viscosimeter, at a 25°C temperature, in the domain of the rate gradients of 0.5 - 437 s^{-1}.

3. Results and Discussions. The obtained results are presented in the following under the form of curves which represent the variation of the apparent viscosity function of the shearing stress (Figs. 1-5).

From the obtained values for the apparent viscosity and the rate of the curves presented in Figs. 1-5, one can notice that the studied products are alike from a rheological view point but, at the same time, are also similar with the reference agglutinants.

The appeared differences are connected with the concentration of the pastes (the content of the dried substance) for the studied CMC-based agglutinants; the

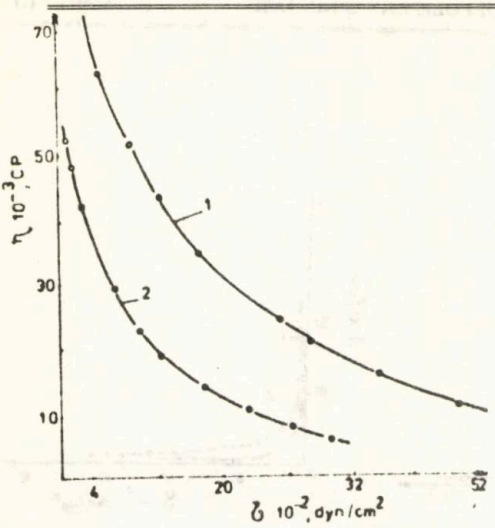

Fig. 1

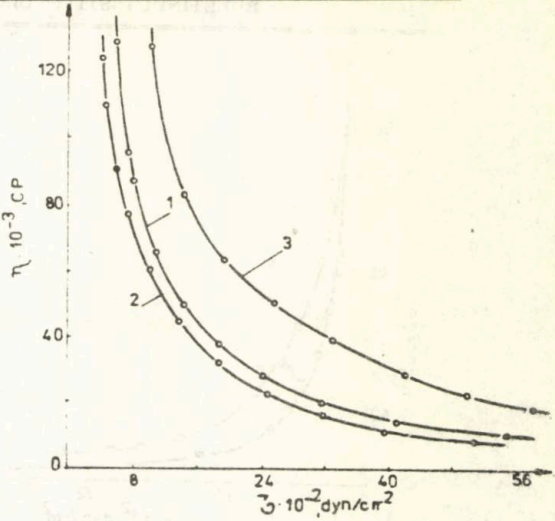

Fig. 2

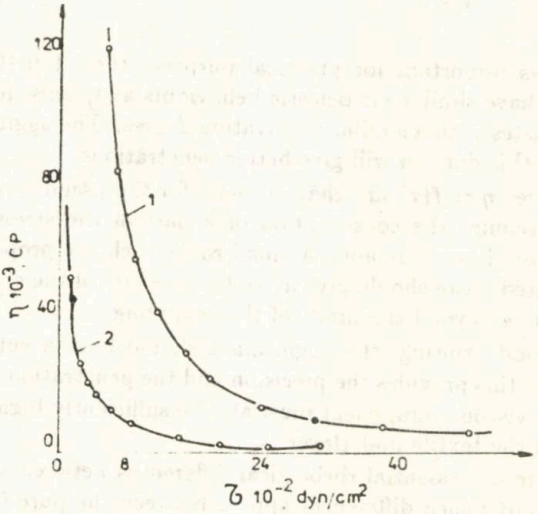

Fig. 3

necessary concentrations for obtaining a viscosity similar to that of the marks belong to a large, i.e. from 5% for the technical product to more than 10% for the modified CMC sample.

The higher content in dried substance will ensure the precision of the pattern by the capillarity it gives to the pastes; the retaining of the capillary water prevents the diffusion of the dye.

From the contour of the rheological curves, one can notice that in the domain

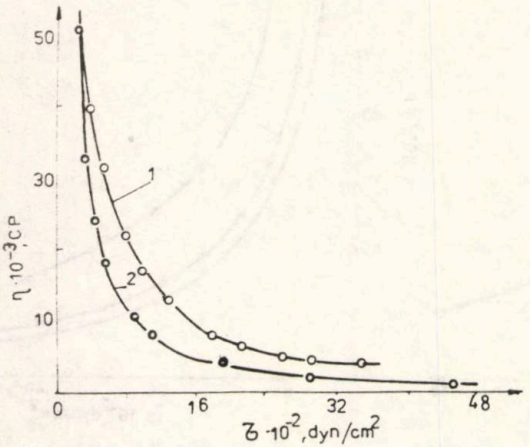

Fig. 4

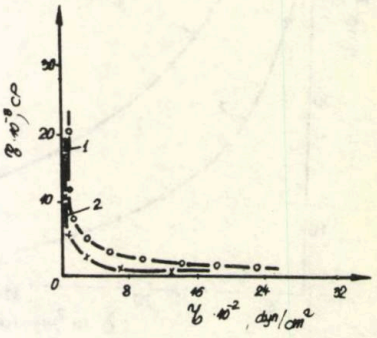

Fig. 5

of the stresses important for practical purposes (i.e. 100-10,000 dyn/cm^2), the agglutinants have similar viscoelastic behaviours and, consequently, they will produce print pastes with a similar penetration degree. The agglutinants with smaller viscosities in this domain will give better penetrations.

The curves $\eta = f(\tau)$ are characteristic for the pseudoplastic agglutinant systems which require the consumption of a part of the stress so that the elastic component could be overcome. A small ratio of elastic properties is necessary so that the printed paste should give up to the pressure of the cylinder or of the blade without passing beyond the limits of the engraving.

For a good printing, the agglutinant should have a sufficiently high plastic component as this provides the precision and the penetration of the pattern during printing; the viscous component must also be sufficiently high as to counteract the capillarity of the textile underlayer.

There are not essential rheological differences between the various treatment variants of CMC; such differences appear between the pure CMC (sample II) and the technical CMC (sample I).

On the basis of the likeness between the rheograme and the viscograms for the CMC products with those of the reference agglutinants, one can assume that the studied agglutinants will give good precision and penetration during printing.

The addition of some substances (salts, alkalis, acids, urea), diminishes the viscosity of the agglutinants even without a supplementary water supply for dissolving; some of these substances are introduced in a solid state.

The modification of the pastes viscosity can result from the breaking of the intermolecular bonds and of the hydration shells, so that a parallelization of the macromolecules, thus, a decrease of the internal friction (viscosity) is produced

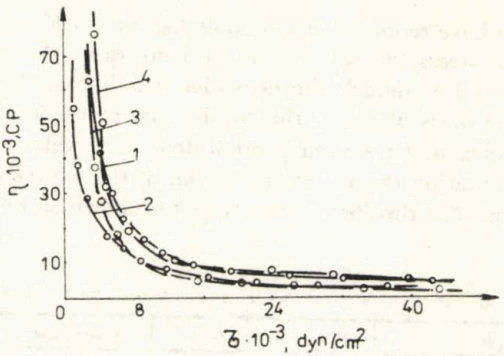

Fig. 6

(Fig.6).

The additions introduced into the formulas have produced a fluidization of the CMC pastes, the most evident effects being produced by NaOH and urea. The fluidization of the solutions has been noticed as well, but to a lesser degree, in the mixtures with Na_2CO_3, NaCl, phosphate or Na_2SO_4.

An important problem for the print pastes is the stability in time of the viscosity. Some tests for the viscosity of the II-nd agglutinant paste have been done for a 7% concentration and a given gradient of 144 hours (Fig.7). It is to be noticed that the viscosity starts essentially decreasing after 72 hours (curves *4* and *5*). The curves *1*, *2* and *3* are for 0; 24 and 48 hours.

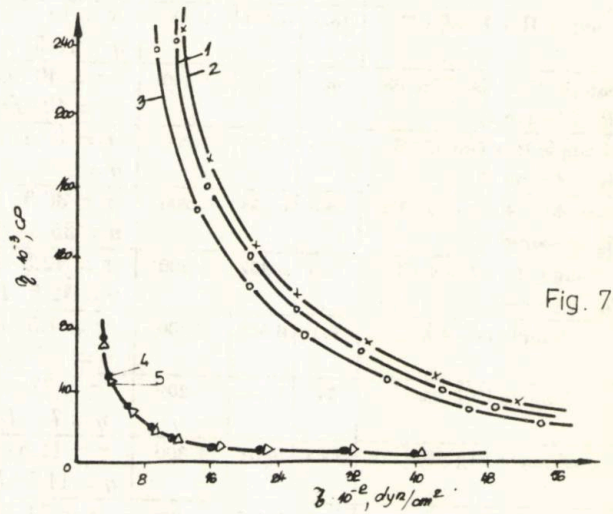

Fig. 7

To deduce the material constants which characterize the rheological behaviour

of the studied pastes, we have represented in double logarithmical coordinates the variation of the shearing stress function of the shearing rate. According to the O s t w a l d de W a e l e model, the dependence is linear, the intersection with the ordinate on the basis of which the consistency index K and the slope representing the flow index n, have been computated. The valeus are given in Table 2, for each determination the variation domain of the experimentally used shearing rate being given. The rheological equations are shown as well.

Table 2

The values of the consistency index and of the flow index

No.	Sample	k	n	D_r, s^{-1}	Rheological equations
1	Indalca PA-30 5%	2.9	0.716	1-300	$\tau = 2.9 \cdot D_r^{0.716}$ $\eta = 2.9 \cdot D_r^{-0.284}$
2	Manutex 5%	17.5	0.576	0.5-200	$\tau = 17.5 \cdot D_r^{0.576}$ $\eta = 17.5 \cdot D_r^{-0.424}$
3	Sample I 12%	87	0.482	0.5-30	$\tau = 87 \cdot D_r^{0.482}$ $\eta = 87 \cdot D_r^{-0.518}$
4	Sample I 15%	430	0.389	0.5-3	$\tau = 430 \cdot D_r^{0.389}$ $\eta = 430 \cdot D_r^{-0.611}$
5	Sample I + CH_3COOH 7%	49	0.462	1-300	$\tau = 49 \cdot D_r^{0.462}$ $\eta = 49 \cdot D_r^{-0.538}$
6	Sample II 5%	39	0.50	3-200	$\tau = 39 \cdot D_r^{0.50}$ $\eta = 39 \cdot D_r^{-0.50}$
7	Sample II 7%	100.6	0.452	1-150	$\tau = 100.6 \cdot D_r^{0.462}$ $\eta = 100.6 \cdot D_r^{-0.548}$
8	Sample II + H_2SO_4 7%	18.5	0.474	1-200	$\tau = 18.5 \cdot D_r^{0.474}$ $\eta = 18.5 \cdot D_r^{-0.526}$
9	Sample II + Na_2CO_3 7% Fig. 6 (curve *1*)	40	0.479	1-300	$\tau = 40 \cdot D_r^{0.479}$ $\eta = 40 \cdot D_r^{-0.521}$
10	Sample II + NaOH 7% Fig. 6 (curve *2*)	19.5	0.538	1-200	$\tau = 19.5 \cdot D_r^{0.538}$ $\eta = 19.5 \cdot D_r^{-0.462}$
11	Sample II + Na_2SO_4 7% Fig. 6 (curve *3*)	36.5	0.455	1-200	$\tau = 36.5 \cdot D_r^{0.455}$ $\eta = 36.5 \cdot D_r^{-0.545}$
12	Sample II + NaCl 7% Fig. 6 (curve *4*)	42.5	0.452	1-200	$\tau = 42.5 \cdot D_r^{0.452}$ $\eta = 42.5 \cdot D_r^{-0.548}$
13	Sample IV_A 5%	7.5	0.588	3-300	$\tau = 7.5 \cdot D_r^{0.588}$ $\eta = 7.5 \cdot D_r^{-0.412}$
14	Sample IV_A 7%	77	0.424	1-200	$\tau = 77 \cdot D_r^{0.424}$ $\eta = 77 \cdot D_r^{-0.576}$
15	Sample VI_A 5%	11.5	0.576	1-300	$\tau = 11.5 \cdot D_r^{0.576}$ $\eta = 11.5 \cdot D_r^{-0.424}$
16	Sample VI_A 7%	34	0.427	1-200	$\tau = 34 \cdot D_r^{0.427}$ $\eta = 34 \cdot D_r^{-0.573}$

The subunitary values of the flow index indicate for all the mixtures a pseudoplastic behaviour characterized by the decreasing of the apparent viscosity with the increase of the shearing rate; the curves obtained at a continuously increasing shearing, do not coincide with those obtained at a continuously decreasing shearing rate (hysteresis curves, Figs. 1, 2). The pastes can be included from a rheological view point in the category of thixotrop fluids.

In the thixotrop system, the individual macromolecules and their aggregates form a tridimensional structure. Under the action of the shearing force this structure is destroyed just like the solvation shells are, the transition from sol to gel is thus produced and the viscosity decreases.

4. Conclusions. 1. Between the CMC-based agglutinants and the reference ones, there exist rheological differences reflected in the various values of the viscosity for the same shearing rates. These differences can result from different chemical structures.

2. The behaviour of the tested agglutinants is pseudoplastic, the appearance of the hysteresis loops showing a moderate thixotropy.

3. Between the various variants of CMC-based agglutinants, there appear differences resulting from the nature of the accomplished mixtures as well as from the different working concentrations.

4. In what the stability in time is concerned, there appear changes revealing a decrease in viscosity after 72 hours.

5. The addition of some substances characteristic for the print pastes diminishes the agglutinants viscosity even without water supply, probably by breaking the hydration shells with the decreasing of the internal friction.

6. From the accomplished rheological study, one can temporarily conclude that for the mark agglutinants and for those studied, the rheological equations are similar and therefore the pastes could be applied with good results in printing.

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CARACTERIZAREA REOLOGICĂ A UNOR AGLUTINANŢI PE BAZĂ DE CARBOXIMETILCELULOZĂ

(Rezumat)

Lucrarea prezintă o caracterizare reologică a unor aglutinanţi pe bază de carboximetilceluloză. Se prezintă relaţiile O s t w a l d de W a e l e şi curbele de curgere care indică o comportare pseudoplastică cu fenomene moderate tixotropice.

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EXPERIMENTAL PROGRAMS IN THE STUDY OF POLYMER PROCESSING

BY

MIRCEA-DAN BUCEVSCHI and MIHAI RUSU

1. Introduction. The quality of the products obtained from polymer processing depends – to a considerable extent – on the values attributed to the technological factors involved. Among the methods suggested for facilitating the decisional steps, some of them propose the application of some mathematical models [1, 2] offering both advantages and decisive limitations. Its utilization – quite restricted – in designing technologies of macromolecular compounds processing is explained by the excessive increase of the costs required for experimental driving up of the mathematical model, when more than 6-8 factors have to be correlated.

The paper discusses a mathematical model applicable to polymer processing, for making leather substitutes, considering an increased number of technological factors, based on an experimental program involving quite a low number of experiments.

2. Mathematical Models and Experimental Programs. The mathematical models mainly applied in studies of polymer processing are of the empirical (statistic) – type, their clasification being based on two criteria, namely: the variables character and the complexity of their mathematical expression.

As it is generally known, the variables of any model are the technological factors involved in the process, namely: the receipt of fabrication applied (i.e., nature and dosage of the compounds) and the technological parameters (temperature, pressure, duration, etc.). As depending on the way chosen for their variation, two possibilities exist, assuring differentiation of the variables considered, namely:

a) *independent* variables – no clear-cut distriction being made between the fabrication receipt and the technological parameters, each factor being permitted to take any value within a pre-established, specific domain.

b) *bound* variables – a case in which only the fabrication receipt is considered, in the form of a mixture in which each compound is expressed as a weight fraction, the resulting restriction (bound) expressing that the value of a variable is conditioned

by the values attributed to the other ones.

The character of the variables influences the form of the mathematical expressions; thus, in the case of independent variables, the model is a free-term polynomial, $\hat{P}_i$, while a polynomial without a free term is to be met in the case of bound variables, $\hat{P}_l$:

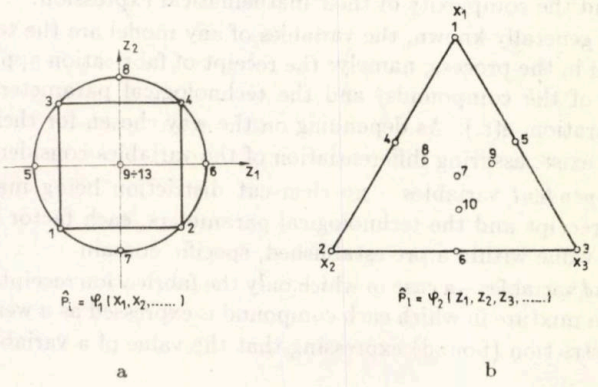
$$\hat{P}_i = a_0 + \sum_{i=1}^{m} a_i x_i + \sum_{\substack{i=1 \\ j>i}}^{m-1} a_{ij} x_i x_j + \sum_{i=1}^{m} a_{ii} x_i^2 + \cdots \tag{1}$$

$$\hat{P}_l = \sum_{i=1}^{n} b_i z_i + \sum_{\substack{i=1 \\ j>1}}^{n-1} b_{ij} z_i z_j + \sum_{\substack{i=1 \\ j>i \\ k>j}}^{n-2} b_{ijk} z_i z_j z_k + \cdots \tag{2}$$

where: m, n – number of variables; x, z – variables of the model; a, b – coefficients of the model.

The models complexity is given by: the polynomials degree, the structure of "interactions" (as produced by the variables), the number of terms. From this point of view, models with independent variables, frequently utilized, are polynomials of the second order, with maximum 6 variables [3, 4]. The mixture models are more diverse, special mention being made of the restricted cubic-type [5], cubic [6] and quartic [7] polynomials, also with maximum 6 variables.

In its turn, the mathematical model determines the number and organizational way of the experiments performed for coefficients estimation. among the models with independent factors, the factorial, composed, centrate, rotable programs [4] – ploted in Fig.1a – are worth mentioning. In the case of models with bound variables, there are mainly utilized simplex, centrate programs, the structure of which is illustrated, by way of example in Fig.1b [8].



a b

Fig. 1

The number of experiments, N, required for estimating the coefficients of the representative models are:

– square

$$N_i = 2^{m-r} + 2m + m_o \tag{3}$$

– restricted cubic

$$N_l = n + \frac{1}{2}n(n-1) + \frac{1}{6}n(n-1)(n-2) + n_o \tag{4}$$

where: r – degree of sectioning of the whole factorial program ($r = 0$ for $m = 4$; $r = 1$ for $4 < m \leq 8$; $r = 2$ for $8 < m \leq 12$);

m_o, n_o – replicated (parallel) experiments [4].

The major disadvantage brought by the utilization of empirical models are:

– exceeding of the usual availabilities in both investment and research activities, when more than 6-8 factors have to be correlated, as due to the excessive increase of the number of experiments;

– the impossibility of correlating the technological parameters with the fabrication receipt, when applying models with bound variables.

For the elimination of such shortcomings, a new mathematical model – "the combined model", P_c – has been elaborated, employing both independent and bound variables, its mathematical form representing a product of polynomials, according to the characteristics of the variables:

$$\hat{P}_c = \hat{K}_i * \hat{P}_l \tag{5}$$

The form for a combined model (5) has been deduced from the expression of the relative value of a certain property (6), when a real reference value is imposed, and when a group of arbitrarily chosen factors acts, thus:

$$k = P_f / P_e \tag{6}$$

where: K – relative value of property P; P_f – real reference value; P_e – real value of property P under the influence of relative factors.

In such cases, a reference technological condition (receipt and technological parameters) is called for, two experimental programs being performed: a simplex one, for constant technological parameters – from which the $(P_e)_{N_l}$ vector results – and a factorial program, for constant receipt, leading to the $P_f)_{N_i}$ vector. On calculating the n_o replicates mean, the following value:

$$V_e = \frac{1}{n_o}\sum_{i=1}^{n_o} P_{e,i} \tag{7}$$

is obtained.

Further on, the $(P_f)_{N_i}$ vector is transformed in to $(K)_{N_i}$, by its division to the scalar V_e, the $(P_e)_{N_i}$ and $(K)_{N_i}$ vector being utilized for calculating the coefficients of $\hat{K}_i$ and $\hat{P}_l$ models.

The combined generalized mathematical model (6) may be utilized in two distinct variants:

– only one premixture, involving selection of a limited number of compounds, for which the nation of "premixture" acquires a scientific meaning (that of group of plasticizers, stabilizers, etc.), the remaining components being cinsidered as independent variables (to which, in this case, one more parameter is to be added – namely, the premixture dosage). The mathematical model for this variant is expressed by relation (8):

$$\hat{P}_c = \hat{K}_f * \hat{P}_a \tag{8}$$

$$a = n - c \tag{9}$$

$$f = m + c + l \tag{10}$$

where: a – number of compounds in the premixture; n – number of compounds in the fabrication receipt; c – number of compounds in the receipt representing independent variables; m – number of technological parameters; f – number of independent variables.

– several premixtures, when the receipt structure permis the compounds organization in different premixtures. The number of independent variables is supplemented with the number of parameters; the mathematical model being given by the following relation:

$$\hat{P}_c = \hat{K}_f * \hat{K}_{a_1} * \hat{K}_{a_2} * \cdots * \hat{K}_{a_{p-1}} * \hat{P}_{a_p} \tag{11}$$

where: $a_1, a_2, ..., a_p$ – number of compounds in the premixtures; p – number of premixtures; $\hat{K}_{a_1}, \hat{K}_{a_2}, ..., \hat{K}_{a_{p-1}}$ – premixtures models with bound variables, expressed as relative values; $\hat{P}_{a_p}$ – mathematical model of a premixture expressed as real values; $\hat{K}_f$ – mathematical model for the independent variables, expressed as relative values.

$$f = m + p \tag{12}$$

when: $a_1 + a_2 + a_3 + \cdots + a_p = n$ (13)

The number of experiments required for estimating the coefficients of the polynomials in the combined model is given by relation:

$$N_c = N_i + N_l - n_0 \tag{14}$$

The advantages offered by the combined model, involving reduction of the number of the experiments concomitently with increasing the number of correlated technological factors, are illustrated in Fig.2.

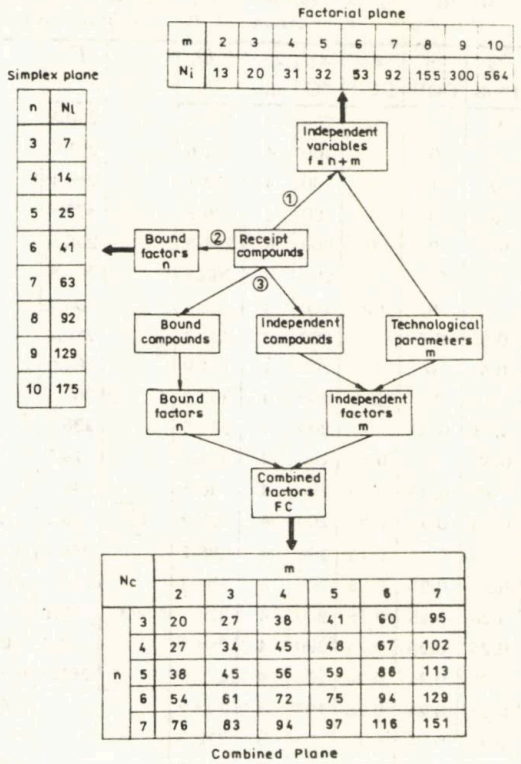


Fig. 2

3. Application. Testing of the combined mathematical model was performed on a compound of polyvinyl chloride, plasticized and expanded, in which bound variables belong to the premixture of plasticizers, while temperature and gelatinization time were selected as independent variables [9]. The property estimated with the model was the degree of expandation.

The experimental matrix and the precision of the model are presented in Table 1.

The precision of the combined model is equivalent to that offered by the statistical models usually applied.

4. Conclusions. The combined mathematical model permits the study of the technologies of polymer processing by correlations the fabrication receipt with the technological parameters, on increasing the total number of variables and decreasing the number of experiments necessary, as compared with traditional statistic

Table 1

Structure of the combined experimental plan and the degree of precision of the resulting model

No.	z_1 DOA	z_2 DOS	z_3 DOP	z_4 BBP	x_1 °C	x_2 min	ED_e %		P_e		ED_c %	E_r %
1	1	0	0	0	200	4	220.5		220.5		212.1	3.83
2	0	1	0	0	200	4	261.6		261.6		251.58	3.83
3	0	0	1	0	200	4	264.1		264.1		253.9	3.83
4	0	0	0	1	200	4	379.8		379.8		365.2	3.83
5	0.5	0.5	0	0	200	4	298.5		298.5		274.5	8.01
6	0.5	0	0.5	0	200	4	263.5		263.5		253.4	3.83
7	0.5	0	0	0.5	200	4	306.3		306.3		294.56	3.82
8	0	0.5	0.5	0	200	4	289.2		289.2		278.1	3.81
9	0	0.5	0	0.5	200	4	304.9		304.9		293.2	3.82
10	0	0	0.5	0.5	200	4	302.8		302.8		291.2	3.83
11	0.33	0.33	0.33	0	200	4	235.5		235.5		224.8	4.52
12	0.33	0.33	0	0.33	200	4	314.7		314.7		299.2	4.91
13	0.33	0	0.33	0.33	200	4	248.1		248.1		237.0	4.47
14	0	0.33	0.33	0.33	200	4	319.2	V_e	319.2	K	303.5	4.9
15	0.25	0.25	0.25	0.25	200	4	288.7		288.7	1.01	259.6	10.05
16	0.25	0.25	0.25	0.25	200	4	296.3		296.3	1.037	259.6	12.36
17	0.25	0.25	0.25	0.25	200	4	272.1	285.6	272.1	0.952	259.6	4.56
18	0.25	0.25	0.25	0.25	200	4	289.3		289.3	1.012	259.6	10.24
19	0.25	0.25	0.25	0.25	200	4	281.9		281.9	0.987	259.6	7.88
20	0.25	0.25	0.25	0.25	195	3	143.9			0.503	159.3	10.74
21	0.25	0.25	0.25	0.25	205	3	219.3			0.769	247.2	12.49
22	0.25	0.25	0.25	0.25	195	5	237.5			0.831	235.7	0.75
23	0.25	0.25	0.25	0.25	205	5	415.4			1.454	42.00	1.11
24	0.25	0.25	0.25	0.25	190	4	169.2			0.592	155.1	8.3
25	0.25	0.25	0.25	0.25	210	4	474.2			1.66	427.3	9.88
26	0.25	0.25	0.25	0.25	200	2	154.7			0.541	127.2	17.74
27	0.25	0.25	0.25	0.25	200	6	405.2			1.419	376.4	7.17

$$K_i = 0.961 + 0.252x_1 + 0.23x_2 + 0.0292x_1^2 + 0.0892x_1x_2 - 0.00726x_2^2$$

$$P = 220.5z_1 + 261.6z_2 + 264.1z_3 + 379.8z_4 + 177.8z_1z_2 + 84.9z_1z_3 + 24.6z_1z_4 + \\ + 105.4z_2z_3 - 63.2z_2z_4 - 76.6z_3z_4 - 1461.3z_1z_2z_3 + 322.2z_1z_2z_4 - \\ - 1179.3z_1z_3z_4 + 572.1z_2z_3z_4$$

ED_e = experimental expandation degree

ED_c = calculated expandation degree

$$Er = (ED_c - ED_e)/ED_e \cdot 100$$

models.

The presence of bound variables the independent ones, permits to observe the

synergetic effects in the receipt of fabrication in their maximization as compared with technological parameters.

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PROGRAME EXPERIMENTALE PENTRU STUDIUL PRELUCRĂRII POLIMERILOR

(Rezumat)

Lucrarea prezintă structura programelor experimentale pentru elaborarea unor modele matematice constituite din variabile independente şi legate, destinate prelucrării polimerilor. Se dă o aplicaţie în domeniul prelucrării compoundurilor de policlorură de vinil plastifiate şi expandate.

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PARAMETERS FOR THE EVALUATION OF OPERATIONAL BEHAVIOUR OF A FLEXIBLE SEWING LINE

BY

VIORICA FRUNZĂ and COSTACHE RUSU

1. Introduction. Manufacturing companies in Romania are currently undergrowing structural changes affected by the new economic environment. Garment companies are particularly affected by short-term changes, for example by fluctuations in the capacity required for small-series production, by the increasing requirement for customized solutions and by disturbances.

Because of these economic constraints, garment companies can survive successfully in the market only if they are in a position to react swiftly to change. In production terms this demands short door-to-door times for parts and a high level of adaptability coupled with intensive utilization of productive resources. The achievement of modern manufacturing concepts particularly implies the use of flexible manufacturing systems.

There is a real interest towards flexible manufacturing systems in the Romanian garment industry. This paper presents the most important results concerning the operational behaviour of the traditional line in the sewing room and the remarks to a system of parameters for the evaluation of flexibility.

2. Operational Behaviour of a Sewing Line. The achievement of a flexible system, as the sewing line is, must make an answer to the following questions:

– what are the recommendable levels of mechanization and automation?

– what is the valid general structure of the system (elements, configuration, dimension and relationships)?

So the production system generally and the manufacturing system especially, are oriented to change the traditional sewing line in relation with the projects of the systems' designers under the real conditions. To permit an evaluation of operational behaviour it is, however, first necessary to define appropriate parameters.

The productivity of the traditional sewing line may be characterized by the parameters "technical availability" (TA) and "actual utilization" (AU).

Technical availability (TA) is a measure of the reliability of technical compo-

nents of the sewing line and it is defined as the difference between "system operating time" (T) and "non-productive time due to technical causes" ($T_1 + T_2 + T_3$). The parameter TA yields data on the proportion of machine operating time available for production. So: $TA = T - (T_1 + T_2 + T_3)$, where T_1 – non-productive times due to system technology (emptiness working); T_2 – non-productive times for direct technical reasons (attachements changing faults); T_3 – non-productive times for indirect reasons (interrupted part supply, disturbances in re-equiping work stations).

Actual utilization (AU) of the sewing line is less than its technical availability since non-productive times are augmented by organizational non-productive times, often caused by unsatisfactory raw material logistics. So:

$AU = TA - T_4$, where T_4 – non-productive times for organizational reasons (lack of raw materials, cleaning work stations, time lost by waiting for the repair and maintenance personnel).

The parameters for the evaluation of operational behaviour of a sewing line can therefore be calculated as ratios from a combination of system operating time and technical and organizational non-productive times:

$$TA = \frac{TA - (T_1 + T_2 + T_3)}{T} \cdot 100$$

$$AU = \frac{TA - T_4}{TA} \cdot 100$$

The majority of the garment companies assume the same technical availability of the sewing lines to different types of production (great series, small series, batch production) and that is why the actual utilization is less.

3. Operational Behaviour of a Sewing Line in Small Series Production (case study). A flexible sewing line is a system composed of a few number of work stations interlinked with a transport system, able to produce more than 50 variants of the same product, in small batches, with high repetition rates [1].

The case study concerns the comparison between the operating behaviour of a traditional sewing line and of a flexible sewing line as a projected system. The investigation period was $T = 160$ hours. The features and parameters of the real system (a traditional sewing line) and of the projected system (a flexible sewing line) are presented in Table 1. The results are the measure of the investigation about the sewing process of "skirts".

The important remarks in the traditional line are:

– systematic non-productive times were attributed chiefly to waiting and transport times, currently due to the factors as work division of the process – in operations, line dimension – number of work stations, logistic practices, ect.

– the majority of organizational non-productive times were caused by the lack of raw materials.

The projected sewing line, as a system to be organized in modules could reach a higher technical availability (TA). Analysis of non-productive times due to technical faults show clearly that direct technical non-productive times caused

Table 1

Comparison between the operating behaviour of a studied traditional sewing line and of a projected flexible sewing line

Features and parameters	Traditional sewing line	Flexible sewing line
1. Technical basis	Simple sewing machines; simple tools	Flexible equipment; special devices
2. Operating system	One machine/one operator	1-3 different machines/operator
3. Production system	The work piece is sewn by many operators	The work piece is fully sewn by the same operator
4. Inventories	Large intermediate stock	No need of stock
5. Dimension	17 work stations (mechanical and manual) 17 operators	7 modules 12 sewing machines (multioperation units) 7 operators
6. Division of the working process	17 operations	7 operations
7. Productivity (w)	$7.5\frac{\text{products}}{\text{operator}-8\text{h}}$	$20\frac{\text{products}}{\text{operator}-8\text{h}}$
8. Volume of products (Q)	127 products/8h	140 products/8h
9. The making-up time of a finished product (N_T)	0.886 h/product	0.4 h/product
10. Non-productive times (T_N)	0.17 h	0.080 h
– due to system technology (t_1)	0.02 h	0.005 h
– for direct technical reasons (t_2)	0.03 h	0.010 h
– for indirect reasons (t_3)	0.02 h	0.015 h
– for organizational reasons (t_4)	0.10 h	0.050
11. Investigation period (T)	160 h	160 h
12. Non-productive times in the systems under investigation:		
$T_1 = t_1 \cdot T$	3.2 h	1.6 h
$T_2 = t_2 \cdot T$	4.8 h	1.6 h
$T_3 = t_3 \cdot T$	3.2 h	1.6 h
$T_4 = t_4 \cdot T$	16.0 h	8.0 h
13. Technical availability (TA) $TA = \frac{T-(T_1+T_2+T_3)}{T} \cdot 100$	93%	95%
14. Actual utilization (AU) $AU = \frac{TA-T_4}{TA} \cdot 100$	82.2%	92.1%

by technical faults on the sewing machines in the flexible line were extremely low (T_1) in comparison with the two other types of technical non-productive times (T_2 and T_3).

4. Conclusions. 1. One reason for the evident hesitancy in introducing flexible manufacturing systems on a wider basis is the dificulty of quantifying their benefits.

2. The increase in productivity may be attributed to the sewing line inter-

linkage, in particular to the multi-operation machine and to the reduction of the number of passages between the work stations.

3. Assuring high Romanian garment manufactures availability and utilization is a continous and essential task which has to be performed if the long-term economic viability of the capital-intensive productive resources is to be ensured.

4. The investigation have demonstrated clearly that both the availability and utilization of a flexible sewing line are heavily dependent on the qualifications and commitment of the repair team and especially of the operating staff.

5. Traditional industrial vocations are inadequate for the qualification of personnel working in a flexible sewing line. In future the training syllabus must be widened to include monitoring, organizing and repair and maintenance skills.

6. The production with a flexible manufacturing system could achieve a notable high standard; the high level of qualification allows to understand the change and to do it.

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PARAMETRI DE EVALUARE A COMPORTAMENTULUI OPERAŢIONAL AL UNEI LINII FLEXIBILE DE COASERE

(Rezumat)

Se definesc conceptele „disponibilitate tehnică" şi „utilizare efectivă" ale unui sistem de fabricaţie – linia de coasere, în variantă tradiţională şi într-o variantă proiectată, pentru o perspectivă imediată în industria românească de îmbrăcăminte.

Se prezintă rezultatele unui studiu de caz şi se compară trăsăturile şi dimensiunile parametrilor ce descriu cele două sisteme, în scopul de a motiva acţiunile de flexibilizare a actualelor linii de confecţionare.

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DIMENSIONS OF LEADERSHIP

BY
JACK A. HILL

1. Defining Leadership. While the number of definitions of leadership approximate the number of persons making such definitions, organizational leadership has the attributes of being a process where individuals direct and influence group members in the performance of their task-related activities. Thus, leadership occurs within organization, each of which has three common factors: (1) purpose, (2) people, and (3) hierarchy. The purpose of an organization (or part of an organization) is anything that is to be accomplished. A purpose can be such things as typing letters, making iron castings, cleaning floors, or selling merchandise. People are needed to carry out purposes, and since leadership involves an unequal distribution of power between and among people, there is a hierarchy. The hierarchy is the structure through which authority flows from a source to the point where it is put to use in the performance of any given task.

Since leadership has many ways of being studied, each approach, however, can be categorized. The most common are *The Trait, Behavioral,* and *Factor Approaches.*

2. The Trait Approach. Many persons have attempted to identify leaders by comparing personality and physical traits between effective and ineffective leaders. However no study of leadership traits has ever consistently indentified one set of traits possessed by effective leaders. Further, the trait approach makes no determination of moral behavior. Therefore, within their respective organizations, a dictator or gangster, could be just as much a leader as could a university rector or a priest.

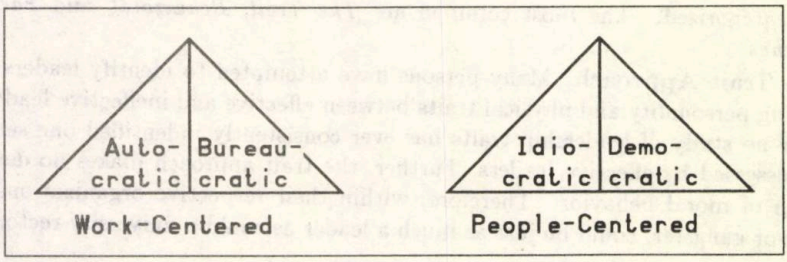
While no consistent pattern of traits can be identified for effective leaders, the absence of certain traits tend to indicate the absence of leadership ability also. That is, while the possession of certain traits is no guarantee of leadership, the absence of such traits most likely identifies a person who will not be an effective leader.

Essential Traits. As one would most likely expect, the following traits exist

for effective leaders: above average intelligence, initiative, and self-assurance. Further, such studies tend to insolate one other factor essential to effective leadership: human relations skills. In effect, the trait approach identifies its own weakness as a concept, and guides researchers to focus on other ways of identifying effective leadership.

3. The Behavioral Approach. Rather than attempting to insolate human traits of leaders, the behavioral approach focuses on what leaders do to attain objectives. For instance, we know that for a *cause* people will follow a leader even though to do so places them in physical danger. Thus people can be led, but not driven. When driven, they only do the very minimum to avoid the imposition of what might considered to be a punishment. While traits are considered to be part of the person and not learned, *behaviors* can be learned. To the extent behaviors can be learned managers can be taught to improve their leadership abilities. Therefore, managers need not take a fatalistic approach to leadership and think that if they had been meant to be a more effective leaders they would have been born that way. Two kinds of leadership behaviors, each having two subsets can be examined: Work-centered leaders, and People-centered leaders.

The suffix *cratic*, means autority while, *auto*, means self, thus the autocratic manager is a manager unto him or herself. *Bureau* means *office*, therefore the bureaucratic leader looks to autority to arise from the office itself. *Idio* is a coined word, but means a small group having inside information from their boss with the result that persons within the group have a concentration of information that they may or may not share with group members. Finally, *demo* means of the people, and the democratic manager looks to support from the workers. This, however, does not mean that workers elect the manager, just that the manager includes them in the formulation of decisions that affect them *before* they are affected.



The Autocratic Manager. This behavior style considers that it is up to him (or her) to make the decisions and that the worker are there to work and not to think. This style may be useful during times of emergency, or when there is insufficient time to consult employees. However, too much of this leadership approach tends to destroy the initiative of employees and they wait for instructions from above before taking action. This manager is also quick to find fault with workers for not doing the job right rather than taking time to determine what might have caused

a problem to develop. Workers under this leader, therefore, have a tendency to surround themselves with "built-in excuses" such as "The electricity failed", "the parts were late in arriving", or "the wrong size was sent me".

The Bureaucratic Manager. All organizations needs rules and procedures to assure consistency and predictability of action. The bureaucratic manager, however, goes out of his (her) way to develop rules and procedures almost needlessly just to remove decision-making from subordinates. The majority of the rules developed by this manager exist to deny freedom of action to employees. However, it is always a matter of balance to determine which procedures exist for the good of the organization and which ones exist to enhance the stature of the bureaucratic manager.

The Idiocratic Manager. This manager carries out his function through a group of subordinate managers with whom he (she) meets on a frequent basis. Communication to the work force is up to the individual members of this group. Working through a sub-group of managers is common in business. The main consideration is for each member of the management team to keep his (her) associates informed with respect to what has been discussed that affects them. In effect, the idiocratic leader runs a risk of poor communication with employees by leaving the responsability up to a small group of managers who meet with him (her) on a regular basis.

The Democratic Manager. This is a style of leadership where the leader discusses objectives and decisions needed to attain them with workers. The democratic manager does not ask the group to make the decision, but announces that a decision needs to be made within a specific time frame, and what his (her) thoughts are and that employees thoughts are wanted before the decision is made.

Actually, a continuum exists from the autocratic style to the democratic style. The autocrat makes the decision and announces it, the bureaucrat may attempt to "sell" an idea or even present a solution subject to change, and eventually, the democratic manager provides subordinates freedom to make decisions within a range of delegated authority.

Research has shown that effective managers shift their leadership style based on a series of contingencies or other factors that influence them. One manager many act autocratically under one set of circumstances than another manager would consider appropriate for a group decisions. In effect, each manager rises to his (her) own level of leadership style.

Time and other conditions influence the style of leadership that makes for leadership effectiveness. For instance, an organization on the verge of bankruptcy will have its employees more willing to follow a highly decisive and charismatic leader while one that is well-established will more than likely have employees wanting to be asked for their opinions.

4. Two-Factor Approach to Leadership. Some students of leadership feel two factors dominante how persons approach leadership: their concern for work (production), and their concern for people. In this two-factor approach, the autocrat is said to have a high concern for work, and a low concern for people. The bureaucrat

takes a middle course and tries to maintain morale while pursuing the necessary production, but relies of established procedures rather than leadership. Some managers feel it is inappropriate to push workers toward goals. Instead they have more or less an apologetic approach by intimating that if it were not for outside pressures "we would not have to work so hard". While this style sounds improbable. it tends to exist in governamental type agencies or ones that are bounded on all sides by many rules and regulations. And, of course, the democratic leader places a high regard on work and on people. This leader tries to help employees develop an interdependence between their personal goals and those of the organization.

5. The Influence of the Organization's Culture. Each organization requires a different style of leadership even though all styles have many common threads. However, here are cultural factors that organizations have that may influence the style of leadership. Top management has certain expectations and these expectations affect how managers throughout the organization go about fulfilling their obligations. The jobs to be done have a major impact on how leadership is practiced. If jobs are highly technical, for example, leaders are expected by subordinates to have a high degree of technical skill. Lastly, organizations with any degree of history, have a built-in set of written and unwritten procedures that influence "the way we do things here". When the culture is such that the organization is moving toward its objectives, the leader's job is simplified because major changes are unnecessary. However, if an organization is not meeting its goals, the leader has a major challenge in the undertaking of and the implementing of a set of decisions that bring about a shift in the organization's culture. In short, "there will be new ways of doing things if the organization is to survive".

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DIMENSIUNILE CONDUCERII

(Rezumat)

Actul conducerii are multiple dimensiuni. Acestea se întind de la căutarea persoanelor care să posede anumite trăsături pînă la selectarea unui stil comportamental în conducere şi care să orienteze organizaţia spre îndeplinirea obiectivelor.

Viitorul conducerii pare să atragă atenţia asupra factorilor neprevăzuţi care pot influenţa stilul de conducere necesar atingerii scopurilor organizaţiei.

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